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FATHER KNICKERBOCKER'S DAILY FARE.—[See page 579.]

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

Horse Living Versus Horse Power

In the Scientific American of January 18th we published an illustration based on tables prepared by the Electrical Engineering Department of the Massachusetts Institute of Technology, showing how far horse, gasoline and electric trucks of different capacities could travel per dollar. The expenses of the trucks were represented in the form of loads dragged along the ground behind them. In each case the load was made up of four different items, one representing the charge for feed, fuel or electricity, another for maintenance, the third for the garage or stable, including driver and helper, and the fourth for overhead charges.

Where the horse showed to the greatest disadvantage as compared with the motor, was in the cost of feed. Herein is the principal difference between animal and mechanical powers. The reason is that the horse is using fuel constantly, whereas the motor vehicle is using its supply of energy only when performing work. To put it differently, the horse is paid (in feed) by the day, while the motor is paid by the job (in gasoline or electricity). Work with a horse is a by-product. Most of the energy fed to it, is employed in building up and maintaining its own bodily health. If a horse required no food during its idle hours there would be little chance for the motor truck except in special conditions. To be sure, a working horse is fed more than an idle horse, but it does not necessarily follow that the extra feed will all be converted into useful work.

It is very important to know just what return the horse is giving for the food it receives, because it eats fuel or fuel equivalent much more rapidly than the motor. On another page will be found an illustration based on figures furnished by the Massachusetts Institute of Technology showing how much work a horse does in an average working day, when engaged in the service of hauling freight from a railroad freight house to a dealers' warehouse. This is not necessarily typical of all lines of transportation, but it does show that the actual work done by a horse may be far less than one would suppose without study. As depicted in our illustration, the horse truck was moving only 40 per cent of the working day, it was traveling between warehouse and freight house only 19 per cent of the day, and during only 15 per cent of the day was there at least a partial load on the wagon. A working horse may be given as much as 33 per cent more oats than an idle horse, in return for which it may be working only about an hour and a half out of a working day of ten hours, or only about 6 per cent of the entire twenty-four hours, during all of which time it is consuming fuel for its own maintenance.

As it is principally in fuel consumption that the motor truck shows its superiority over the horse truck it is obvious that under conditions where actual work is done during only 15 per cent of the working day, the motor truck may show but little more efficiency than the horse truck. Obviously, under such conditions the remedy is to adjust the work so that the truck will keep moving practically all the time with full load. This can be accomplished only by using special loading and unloading devices. A common practice is to provide separate bodies which may be loaded and unloaded at leisure without delaying the truck. Still another suggestion is to use trailers which may be coupled to the truck with a minimum of delay. The motor truck will then be the equivalent of a locomotive. In fact, Mr. Morgan Cilley, writing in a recent number of the *Engineering Record*, proved that in many situations a motor truck can do better work hauling trailers than carrying the same load on its own wheels. The motor vehicle is too valuable a machine to stand idle at any time during the working day. If the truck were used as a locomotive many problems of its construction would be eliminated. One of the principal difficulties met with in the ordinary truck lies in the provision of springs suitable for all conditions of traffic. If the springs are heavy enough for the fully loaded truck they will be stiff enough to rack the mechanism when the vehicle is running empty.

It may be thought that various time-saving expedients can also be applied to the horse. While there is no doubt that a better return for the investment can be made by reducing the idle time of the horse, it must be remembered also that it is when moving that the motor truck shows its chief superiority, and also that the horse cannot be kept working constantly all day long, but requires many rest periods for recuperation.

A Simple Parcel Post Wanted

Since the enactment of the Parcel Post law of August 24th, 1912, and its introduction on January 1st, this year, much criticism has been made in the public press about the complications, restrictions and unfairness of the Bourne eight zone system as specified in the law and a demand for a reduction of the number of zones, or instead, the establishment of a low flat rate with an increased weight limit, over the eleven-pound limit now in use.

According to a recent article in the New York *Sun* on "Parcel Post Defects" wherein it refers to the evidence given before the Post Office Department Investigating Committee as being of considerable interest, it goes on to say:

"When, however, responsible merchants declare in their evidence that their use of the parcel post has been reduced by nearly two thirds since its inception and that they have been compelled, however unwillingly, to give their business back to the express companies, it is obvious that something is seriously wrong."

The *Sun* refers to the carelessness in the handling of packages, how in one instance half of the packages sent were received at their destination in a damaged (crushed) condition. It is also stated that in other countries where the system is in effect, damage to packages in transit is comparatively rare, and there appears no reason why a similar security should not be obtained here. It refers to the inconvenience of the special parcel post stamps and advocates a return to the ordinary letter stamp.

Referring to the zone system, the *Sun* continues:

"A more serious difficulty is the zone sgstem, which is confusing and complicated. The enormous size of the country would seem to justify the system, since it appears on the face of it anomalous to carry a parcel a thousand miles for the same price that is charged for five miles. Nevertheless, the shippers who gave evidence on Tuesday were unanimous in asking for a flat rate and in urging that the ideal system would be a bulk rate where shippers could drive a dray load of packages on the scales and pay at so much a pound or ton. If such a system were adopted it would probably be found in practice that the short freights balanced the long. Certainly it would make for simplicity, and if the public is to become habituated to using parcel post to the extent it should be used to justify itself, simplicity in its regulations is a first consideration."

The act of 1912 provides for the change of rates and weight limits and the consolidation of zones by the Postmaster-General subject to the consent of the Interstate Commerce Commission when the cost of the service will not exceed the revenue therefrom.

If the plan mentioned above—"that the short freights balanced the long"—is true, and according to the law of averages it should be, it follows that a single low uniform parcel rate applicable for individual localities as well as great distances should produce sufficient revenue to be self-sustaining.

With the introduction of perfected high-powered automobile postal vehicles capable of carrying large volumes of postal matter direct from one post office to another, over night, between cities a hundred miles apart, much economy of transportation cost would be effected, and the expense of double handling be saved.

A similar use of the automobile rural delivery post wagon has been proposed by the Postal Progress League, where a vehicle should start at each end of the route, on a given hour, in opposite directions and carry merchandise and passengers by the parcel post system. This would facilitate the exchange of farm produce along the route and provide facilities at low rates to the residents on the route for personal transportation.

Postal personal transportation has been in successful use in a few foreign countries for some time. A simplified parcel post based on a single low, yet paying rate, will have a stimulating effect in the transportation of light commodities throughout the country, and encourage trading by mail to a greater degree than ever before.

The Aeroplane in War

Although aeroplanes were used on many occasions during the recent Turko-Balkan campaign, dirigibles were conspicuous by their absence, and there was no organized air-service which could give us any data on which to base our estimate of the value of systematic overhead reconnaissance, or conflicts between the various types of flying machines, or the attack and defense of localities by way of the air. We must therefore hark back to the Turko-Italian campaign in Tripoli for actual war experiences; and although these were very one-sided, in that the Italians had three kinds of aircraft, dirigibles, aeroplanes and captive kite-balloons, whereas the Turks had none, the air service of the former was organized and worked systematically and achieved certain definite results on which we can begin to formulate opinions. On the whole, we gather that both aeroplanes and dirigibles were of great use to the Italians in the matter of reconnaissance. On rare occasions they assisted the artillery to find targets and regulate their fire, and they enabled the staff to correct existing maps by means of photographs, but with regard to dropping bombs the effects of the latter were decidedly moral rather than material.

In certain limited cases as regards inanimate objects of attack, aeroplanes might be effective, as for instance for the destruction of railway lines, since "sowing" a number of bombs, while the machine kept above a length of permanent way, would not be very difficult. As regards the destruction of fixed points, the aeroplane is practically useless, unless large numbers are used, each carrying one or two heavy bombs and coming comparatively close to the ground. Even so, the difficulties in obtaining accuracy of aim from the swiftly moving machine are very great. Besides this, the Italians found that even in face of the indifferent marksmanship of the Turks it was imperative to keep at an altitude of 4,500 feet in order to remain out of range of rifle fire. There is no cover in mid-air, and if the bomb-droppers should descend low enough to take any kind of aim, the attacking aeroplanes would have to run the gauntlet of a fusillade so heavy and sustained as to render sighting difficult and the chances of escape from destruction very slight. Ranging on aeroplanes has been shown to be extremely uncertain on account of their speed, and for other reasons, but the sustained fire of many rifles within say 1,800 feet and necessitating no special adjustment of sights would eliminate the process of range-taking. On the whole, the damage likely to be done by aeroplanes dropping bombs is negligible, the moral effect on good troops most uncertain, and not worth the expenditure of gallant lives and machines which are of much more value for purposes of reconnaissance.

Rail Inefficiency

It has been said that there is no more efficient product of human industry than the steel rail, and this is probably true; but it is also true that there is hardly any element in industrial activity which is so inefficiently employed.

This fact will become apparent when it is considered that a rail is stressed almost to the limit of its endurance, under violent shock and heavy pressure, for a few minutes at a time, and then allowed to remain practically idle for several hours. With the exception of the rails used in and about terminals and yards, it appears that for a very considerable percentage of the time the entire roadbed of a railway system is idle, while for the balance of the time it is violently overworked. No modern manager would venture to work his men in such an irregular and erratic manner.

During the past decade the burden upon the rail has been greatly increased, both as regards engine and cars; and while attempts have been made to improve the rail, in form, weight, and constitution, the fact still remains that it is subjected to conditions far more severe and unequal than almost any other form of structural material.

Just where the remedy lies remains to be determined, but it would seem that before attempting to produce a stronger, or more costly rail, the desirable method of procedure would be to attempt to use the present rail in a more efficient manner. The real usefulness of the rail lies in its carrying capacity, in its effectiveness as a means of transport; and hence such reduction in maximum loads and increase in frequency of trains as would give maximum capacity with nearest approach to uniformity in burden, would apparently lead to maximum efficiency, and to such reduction in stresses as would render breakages extremely unlikely.

It is probable that such a modification in operation would, at first, fail to meet with the approval of traffic managers, as tending to increase the cost of operation; but when the limit of capacity is attained, as seems to be nearly the case, not only with the rail, but possibly with some other elements of the great transport problem, we may be permitted to inquire whether the inefficient use of the steel rail is not simply one among a number of indications that present railroad methods have almost reached that point of maximum capacity which indicates the necessity for radical changes in the entire treatment of the problem.

Electricity

Soldering Enameled Wire.—Now that enameled wire is coming extensively into use for winding electromagnets and for similar work, it is of interest to be able to solder the ends of such wire in a ready manner and especially to clean off the coat of enamel so as to leave the ends bare. Where the wire is very fine, it is a very difficult matter to strip the enamel without breaking the wire, so that the present German method is a timely one. The ends of the wire are dipped for some time in boiling potash lye or in concentrated sulphuric acid, or again in a concentrated and cold lye bath, then washed for an instant with hot water and dried by dipping in alcohol. This leaves a clean surface of metal for soldering.

An Electric Ice-cream Freezer has been devised by a London inventor. In the usual freezer tank, generally of large size for wholesale manufacture, hotels or the like, is mounted a tubular coil supplied from a carbonic-acid machine which takes the place of ice and salt. The small machine is mounted on a wall frame together with a small electric motor which drives it by belt from above, so that the outfit takes up very little floor space. Cleanliness is secured by the entire absence of crushed ice and salt, and there are no wet floors. It is claimed that the electric device also gives considerable economy in working. Another point is that where there are electric motors already in use for other purposes, the ice-cream machine can be driven from them without entailing the extra expense of a motor.

Packing for Lamp Bulbs.—What is known as the "ovigarde" packing for electric lamp bulbs is proving quite a success in France. It consists of an individual wrapping for each lamp which was at first devised for transportation of eggs, whence its name, and was afterward made in a suitable form for lamp bulbs. It consists of an egg-shaped shell made of corrugated paper with the corrugations running parallel to the length of the lamp. The envelope fits tight upon the lamp and is opened entirely down one side so that the wrapping can be opened out for inserting the lamp, then it folds over with an overlapping joint. At the top is a small narrowed part which surrounds and protects the pointed end of the bulb. In this way the lamps can be simply packed in boxes like any kind of loose material without needing any further precautions.

An Electric Gas-analyzer has recently been produced which serves to give a series of rapid analyses of furnace gases so that the combustion may be observed. Usually the amount of carbonic acid (or oxygen) is determined in this way. An electric motor operates all the parts and the rapidly succeeding analyses are recorded on a paper drum in succession. By raising a small water gasometer bell to a given height by the motor, a standard amount of the furnace gas is drawn in, then it goes into a potash absorption chamber where all the carbonic acid gas is absorbed. The remainder passes from here into a second gasometer whose bell is on the end of a lever, and the bell rises according to the amount of gas sent into it. Should no gas be absorbed, the second gasometer receives the full 100 per cent of the standard amount, and the pen attached to it by a light arm now rises to the top or to the zero line and makes a dot by an electromagnetic device, showing no carbonic acid. Were 30 per cent absorbed, it would rise less and indicate this latter amount. Then the gas is evacuated and a fresh analysis made, and so on quite automatically, once in about every five minutes.

An Ocean Telephone.—On May 1st what is probably the first ocean telephone call station was opened for public use. This is in Platte Fougère lighthouse on a rock lying about 1¼ miles to the northeast of Guernsey, Channel Islands. The lighthouse, which has no keeper, is fitted with a powerful fog signal, worked from shore by means of a submarine cable. In a fog ships creep up guided by the fog horn and drop anchor near the lighthouse until the fog lifts sufficiently to enable them to take the narrow channel to the harbors of Guernsey. In such case any pilot or ship's officer by climbing the lighthouse can ring up Guernsey telephone exchange and report his ship. The telephone is reached by climbing a 42-rung ladder to the platform outside the lighthouse doors. Before he can leave the ladder the pilot pushes open a trap door which covers the manhole in the platform. The arrangement is such that the pilot cannot open the lighthouse door to reach the telephone until he has shut down the trap door over the manhole. The act of opening the outer lighthouse door connects the telephone fitted outside the inner door of the lighthouse, which is kept locked. Only one wire in the cable is available for the telephone, and even this wire is required for other purposes, and closing the door after using the telephone connects up several tell-tale devices. The lighthouse door cannot be left open by forgetfulness because the pilot must close it before he is able to lift the trap door in order to reach the ladder.

Science

Photographing the Aurora.—Prof. Stormer and Dr. Birkeland spent the months of February and March at Bosekop, in northern Norway, making photographs of the aurora, continuing the remarkable work of two years ago. As in the previous case, photographs have been taken simultaneously from two stations about 2½ miles apart, connected by telephone, in order to furnish means of computing the distance and altitude of the aurora.

Zigzag Lightning.—Photography long ago proved that what was once taken for zigzag lightning is really sinuous; i. e., without sharp angles. Otto Meissner, in *Das Wetter*, offers an explanation of the angular appearance of lightning. He believes that the sudden glare of the flash causes an involuntary movement of the head or eye; the original image of the flash persists for a moment on the retina, along with the image produced on the eye in its new position. Thus we get the impression of a broken line.

Canadian Weather Forecasting is the subject of a useful brochure just published by the assistant director of the Dominion meteorological service, Mr. B. C. Webber. The writer is perfectly frank as to the unsatisfactory scientific side of weather prediction, and attempts to give only a digest of empirical knowledge pertaining to this work as carried on in Canada. It would be an excellent plan if the forecasters in all other countries would put the results of their practical experience on paper in the same way.

A Superstition Concerning Mountain Sickness is reported by Mr. W. Bryce Douglas to prevail in Bolivia, viz., the belief that there is some connection between this affection and the presence of large mineral deposits in the mountains. This belief is reflected in a Bolivian name for the disease—"veta"—meaning literally a lode or vein. The natives thus attempt to explain the fact that the sickness is more or less local in its occurrence, and does not appear to depend solely upon altitude. The pass of Livichuco, on the trail from Challapata to Sucre, is known to contain large deposits of antimony, and is considered a bad place for "soroche" (mountain sickness), some travelers dying when crossing it.

A New Variety of Bean adapted for dry climates was discovered under interesting circumstances by Prof. R. W. Clothier, of the University of Arizona, as reported by him in a recent magazine article. During a 1,300-mile wagon journey over the deserts and mountains of Arizona in the summer of 1908 he visited the Papago Indians, and obtained from them several hundred brownish-yellow beans of an unknown variety. These were grown on experimental plots at the Arizona Experiment Station for four years before the discovery was announced. It appears that the new bean, which has been named "tepary," is more prolific under dry conditions than any other known variety, yielding as high as 730 pounds to the acre with no water other than the scanty rainfall of Arizona. Under the same conditions ordinary beans yield only from 66 to 144 pounds to the acre.

Uses for Calcium Cyanamid.—It is only a few years since it was discovered that nitrogen passed over hot calcium carbide formed a compound valuable as a fertilizer. It is converted into ammonia in the soil and so can be used as a substitute for nitrates. More recent practice passes steam over the cyanamid and converts it into ammonia in the factory. The catalytic action of cerium and thorium oxides on ammonia and air makes it possible to convert this into nitric acid, thus opening up a new market. Fusion of cyanamid with sodium salts converts it into cyanide, valuable in gold mining. By treating cyanamid with water just below the boiling point dicyandiamid is made, a compound useful in the dye industry and in the making of explosives. In Germany they are selling under the names of "Ferrodur," "Intensit," "Hessolin," etc., materials for case-hardening steels. These powders are merely compounds of cyanamid with some alkaline salt and carbonaceous material.

Taking Criminals' Finger Prints on the Spot.—Dr. Heintl recommends a very good method for taking the finger prints of criminals, this not relating to finger-print records in an anthropometric bureau, but where the record is to be taken on the spot where a crime occurred such as on a wall or any object which cannot be moved and where the print is impossible to photograph on account of lighting or other reason. He makes use of a very fine color powder so as to dust it over the prints which are of a more or less greasy nature, and in this way the powder adheres to the finger print and takes all its gradations. Then a specially prepared paper is pressed upon the print and the powder adheres to it so as to give a good copy of the original. Such paper is prepared with a mixture of beeswax and paraffine adding a few drops of glycerine, coating the paper with a thin layer of the same. The paper is of a very flexible kind so that it fits upon the surface of irregular objects. It is said that a gelatine photographic paper has a good surface for taking off powder prints of this kind, and can be employed with success.

Automobile

A Pneumatic Anti-slip for Automobiles.—Patent No. 1,056,044 to Benjamin Douglass, Jr., of Orange, New Jersey, presents an automobile with an explosion engine, an ordinary muffler and a secondary muffler, which last is partly filled with sand and into which the exploded gases are discharged and subsequently silenced, and both mufflers are connected with the explosion engine and connections are provided from the secondary muffler to convey the silenced gases and some of the sand in front of and on either side of one or both of the driving wheels of the automobile so the force of the muffled gases can be used to spread sand to prevent slipping of the wheels.

The "Dog-fish" Body Is the Latest.—We have had submarine bodies and aeroplane bodies, one designer has gone so far as to bring out a terra-marine body, and now comes the "dog-fish" body which is said to represent the very acme of perfection for touring service. The 'dog-fish" body is simply an ordinary touring body, or rather a torpedo body, in which the sides are extended to inclose the running boards, thus providing ample space for the storing of tool boxes, parts, etc. The spare tires are accommodated in a bulbous back and the side door, giving entrance to the compartment over the step, is wide enough to pass a rather large trunk. The horn and the lamps are quite invisible and when folded the top disappears into a compartment at the back of the body. When in touring trim, the car is said to be waterproof.

Automobile Omnibuses in France.—The great extension of automobile omnibus lines throughout France for service in the country districts will be seen when it is observed that there are already 293 different omnibus lines running at present, a total distance of 5,350 miles. The types of autobus or alpine car are supplied by 23 different works, most of which are in the nighborhood of Paris. The different lines which we mention are organized by 179 transportation companies. When it is noticed that three or four years ago there were scarcely thirty of these autobus lines in operation, the progress made in a very recent period is striking. Even now, the matter is at the outset, and just lately the complex problems of operating services of this kind were but little known, leading thus to a hesitation on the part of the communes and the State to furnish subsidies. Lack of co-operation among the companies was another drawback. All this is now changed, and the forthcoming operating data are encouraging the authorities in the matter of subsidies, while the methods of the lines are becoming better established. A general transport syndicate is lately organized, a starting point having been made at the December 1912 Congress. From this time on, a brilliant future is predicted for automobile passenger service. A few examples will show the kind of service in use, for instance the Nice Company operates 10 Berliet autobus in the Maritime Alps region from Nice to Briançon, a total of 170 miles. The same enterprise operates a line from Avignon to Arles, 65 miles. A line from Grasse to Castellane, operated by the Touring Car enterprise, covers 50 miles with Peugeot and other cars. The Auto Transport firm has 8 autobus running between Aix and Barcelonette, 105 miles. Another enterprise has four lines radiating from Montpellier and using 9 De Dion cars, with a distance of 102 miles.

Improvement in Motorcycle Magnetos.—If the solution of ignition problems has done much to advance the automobile business it scarcely can have done less to advance the motorcycle industry. Whereas it is a simple matter to carry almost any kind of ignition apparatus on an automobile, regardless of its complication or bulk, the equipment of motorcycles presents problems which are entirely foreign to any that can crop up in automobile work. In the first place, it is absolutely essential that the ignition apparatus on a motorcycle occupy the smallest possible amount of space, for space is at a premium and the rider can ill afford to have his machine festooned with wiring and cluttered up with batteries and switches and what not. And in the second place, it is even more important that the apparatus which produces the life-giving sparks be waterproof. In these respects, it is interesting to note the really tiny size of the modern motorcycle magneto and the degree of waterproofness which has been obtained. In the majority of cases the magneto is a miniature instrument practically built integral with the motor from which it is driven either by inclosed gearing or by a chain of the "silent" variety. It forms a neat contrast to the bulky and weighty batteries and coils which only about a year ago were standard equipment on all but a very few machines and marks very plainly one very big step forward that motorcycle and magneto manufacturers have made within the past twelvemonth. Also, these newer types of instruments are waterproof in the fullest sense of the word—a statement which could not have been applied with any degree of truth to their predecessors. Without exaggeration, they will operate efficiently with a continuous stream of water playing on their "vitals" without the slightest apparent diminution of their spark-producing proclivities. "Bottling up" the internal economy of the instruments has not been an easy task, though it nevertheless has been thoroughly done.

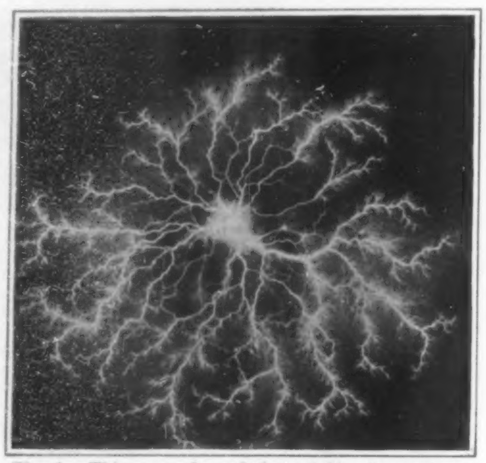


Fig. 1.—This example and that of Fig. 2 are photographs obtained by interposing a sensitized plate between poles of an electrical machine.

Lightning-Prints

A Curious Chapter in the Pathology of Lightning Stroke

By Charles Fitzhugh Talman

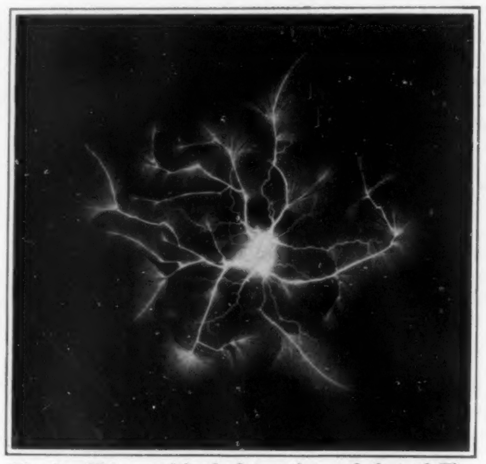


Fig. 2.—This sensitized plate-print and that of Fig. 1 strongly resemble the typical lightning-print shown in Fig. 3.

IN the back of your mind there is probably the vague recollection of having heard that sometimes, after a person has been struck by lightning, the photographic image of a nearby tree or other object is found impressed upon the body. This is one of the ten thousand curious and neglected subjects that will be fully discussed in the as yet unwritten and unplanned Paralipomenon Encyclopædia—that anxiously awaited omnium-gatherum of things left out of the conventional reference-books. The aggregate of the existing literature of the subject, scattered through several languages, is fairly extensive, and the marks in question have occasionally been drawn and even photographed from nature. They are called "lightning-prints" or "keraunographs."

For our present purpose it will be convenient to distinguish two classes of lightning-prints, viz., (1) arborescent forms, popularly supposed to be photographs of trees or other vegetation; and (2) a variety of other forms.

There is no doubt of the frequent occurrence on the bodies of persons who have been struck by lightning of ramifying marks strongly suggesting the appearance of trees, branches, and the like. The accompanying Fig. 3 is drawn from a photograph of such marks on the arm of a boy struck by lightning near Duns, England, June 16th, 1883. The photograph was taken four and a half hours after the accident.[1] Some beautiful colored plates of similar marks (unfortunately too delicate for reproduction here) are given in S. Jellinek's "Atlas der Elektropathologie" (1909).

Formerly by many scientific men, as to-day by the laity, such marks were believed or at least conjectured to be the result of an actual photographic process on the part of the lightning. The following quotation from an interesting collection of lightning-print anecdotes, published in *Chambers's Journal* for November 2nd, 1861, enshrines the old belief: During a terrible storm at Lappion, France, "six workmen and a child received severe shocks, and a woman of forty-four years of age had the image of a tree, trunk, branches, and leaves, distinctly printed in red upon her person. There appears no doubt that in all these cases of lightning-prints, the image produced upon the body indicates the object from which the electrical discharge emanated on its way to the person struck with lightning; in other terms, that the object whose image is produced formed part of the electric circuit." The same idea, though wrapped up in technical language, appears in more scientific discussions of the subject, including some of recent date. Camille Flammarion, in the longer of his two anecdotal works on lightning[2], devotes a chapter to lightning-prints, in which he suggests the existence of "ceraunic rays," emitted by lightning, and capable of photographing alike on the skin of human beings, lower animals, and plants, more or less distinct pictures of objects far and near.

Details of the recorded cases of lightning-prints will be found in A. Poey's "Relation historique et théorie des images photo-électriques de la foudre," Paris, 1864 (on which the above-mentioned article in *Chambers's Journal* is based); in three memoirs by J. C. M. F. Boudin (who introduced the term "kéraunographie" in this connection); in C. Tomlinson's article "On Lightning Figures," published in *Nature*, May 6th, 1875; in Flammarion's book, just referred to; and in many other works. In by far the greater number of cases arborescent forms are said to have been produced. The marks were red or bright pink, and generally disappeared in a day or two. In the original narrative it is nearly always assumed that the marks represent some particular tree, or part of a tree, in the neighborhood, and it is frequently stated that this object was reproduced with absolute fidelity. It is hardly necessary to point out that, given the prevailing belief in the ability of lightning to produce such photographs, there is an excellent opportunity for self-deception as to the accuracy of the supposed delineations. This fact is well illustrated in one of the cases recorded by Flammarion. A man named Elisson was struck by lightning at Pertuis, France, June 17th, 1896, and the newspapers reported that the image of a tree had been found upon his body. M. Flammarion corresponded with the surgeon who attended the case, a Dr. Tournatoire. The latter confirmed the newspaper report, stating that the image undoubtedly represented a poplar tree, standing a hundred meters from the place of the accident. Unfortunately for a good story, the doctor inclosed his own sketch of the lightning-print. (Fig. 4.) The outline is, to be sure, somewhat suggestive of a poplar tree, but only a mind strongly prepossessed with the belief that such marks are always photographs of nearby objects could have confidently identified it with the tree in question. In passing, it may be remarked that a very slight addition to the accompanying sketch would convert the "tree" into a "leaf." This is important in view of the fact that there are several cases on record in which lightning-prints have been identified as photographs of leaves.

Fig. 3.—Aborescent lightning-prints. Drawn from a photograph of such marks on the arm of a boy struck by lightning near Duns, England, in 1883. Photographed four and a half hours after accident. (From "The Lancet.")

Fig. 4.—An alleged lightning photograph of a neighboring poplar tree. (After Flammarion.)

Fig. 5.—Three pieces of the bark of a tree struck by lightning, showing lightning prints on their inner surface. (After Tomlinson.)

In opposition to the popular belief, there has always been a certain amount of skepticism on the part of the few scientific men who have interested themselves in this subject as to the photographic character of the prints. Prof. Pfaffe, in his article on lightning contributed to Gehler's "Physikalisches Wörterbuch" (new ed., 1825) seeks to identify these marks with Lichtenberg figures. A more plausible explanation, which must have occurred to many people before it was definitely suggested by W. Stricker, in 1861,[3] was that these ramifying marks represent the ramifications of blood-vessels, made visible by injection or extravasation under the effects of the electrical spark. However, this hypothesis was disproved by Rindfleisch[4], who dissected the body of a man killed by lightning, and who found the arborescent prints did not coincide in the least with the position and direction of the blood-vessels. To Rindfleisch we are indebted for what is, in all probability, the correct explanation, and it is a very simple one. According to this writer, the ramified marks represent merely the lesions due to the passage through the tissues of a branching electric discharge. The heat generated by such a discharge against resistance accounts for the alteration of the tissues, in this as in other cases of electrical injuries; and the branching of the spark is due to the different resistances encountered, as is true of ramified sparks in general (e. g., those seen in ordinary photographs of lightning in the open air). Further particulars on this subject will be found in the article on lightning injuries (by S. Jellinek) in the recent fourth edition of Eulenburg's "Real-Encyklopädie der gesamten Heilkunde," vol. 2, p. 631 ffg.

It will probably occur to physicists that the typical lightning-print shown in Fig. 3 strongly resembles the photographs obtained by interposing a sensitized plate between the poles of an electrical machine. (Figs. 1 and 2.) Before leaving the subject of arborescent lightning-prints it should be noted that these are sometimes produced on vegetable as well as animal tissues. An example is shown in Fig. 5.

Turning now to the second class of lightning-prints, we are confronted with a number of curious cases, some of which are certainly susceptible of an explanation analogous to that given for the arborescent forms, while others possibly are not. It is easy to believe that the electric spark might produce marks which the uncritical observer would identify as "photographs" of crosses, horseshoes, and other objects that happened to be in the vicinity. It may also be assumed that in many of the more marvelous cases reported the facts have been considerably embroidered by the imagination of the narrators, just as happened in the case of the poplar tree mentioned above. We are inclined to apply this explanation to the following case, reported to the

[1] *Edinburgh Medical Journal*, v. 29, pt. 1, 1883, p. 560-562.

[2] "Les phénomènes de la foudre," Paris, 1905. Translated under the title "Thunder and Lightning," by Walter Mostyn, Boston, 1906.

[3] Virchow, *Archiv*, v. 20, p. 76.

[4] Virchow, *Archiv*, v. 25, 1862, p. 417.

(*Concluded on page 585.*)

Fixing the chemical purity of water for use in bottled goods.

Manufacturing Problems

A New Field for the Industrial Scientist

By F. D. Bell

Determining the specific gravity of syrup for bottling.

THE nature and uses of a factory product determine whether the manufactured article should be the result of combination of several raw materials to form chemical compounds possessing properties distinct from those of the raw materials as, for instance, in glass manufacture, or, whether the manufactured article is the result of partial chemical combination—as in rubber goods—or, finally, whether the particular manufactured product is the result of simple mixture, as in the case of many pharmaceutical and household articles.

In the case of chemical combination, various conditions materially affect the resultant product. The physical conditions, such as temperature and time of interaction, are frequently most important, but strength and purity are very essential. The manufacture of glass, while in all cases the result of combination of similar basic constituents, such as silica and the alkalies, may, by the addition of special ingredients, yield products having the most infinite variety of properties. In this manner window glass, plate glass, lamp globes, bottle glass, thermometer tubing, chemical glassware designed to resist the action of chemical solutions, gage glass designed to resist the action of hot water and sudden changes of temperature, various colored glasses, and a host of others, are the result of proper combination of ingredients which give the desired properties to the finished product.

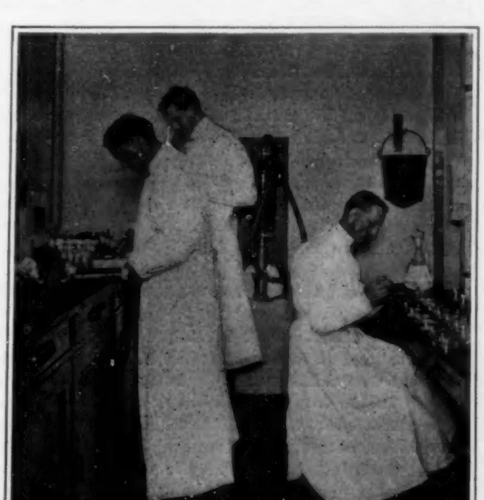
The manufacturer of hydrogen peroxide has spared no effort in searching for a suitable preservative which will enhance the stability of his solutions. Of the greatest importance is the quality of the glass in which the product is bottled, since glass which is readily acted upon by aqueous solutions greatly accelerates the decomposition of hydrogen peroxide.

Alcoholic and aqueous liquids and bottled table waters frequently contain sediments which are the direct result of the action of these fluids on the glass container. In some instances, the alkali of the dissolved glass neutralizes the acidity of liquids to the extent of causing secondary reactions to take place, and in this manner induces certain chemical changes to follow. These changes result in seriously altered flavors and precipitates, which render the product unsalable.

Bottled, non-alcoholic, drinks are subject to many other troubles than those due to the nature of the glass. In some known instances, which it is probably safe to assume are typical of conditions throughout the trade, these prepared drinks are made without any regard to the chemical principles involved, the chemical purity of the raw materials, or the methods employed in putting the ingredients together. Water containing large amounts of lime and magnesia may, with certain fruit acids, cause the direct formation of an insoluble compound which appears as a sediment after the goods are marketed.

Certain grades of caramel coloring, commonly known as burnt sugar coloring, may under certain conditions contain by-products formed in its manufacture, which, when brought into contact with certain flavoring extracts, will cause very dense sediments to form within a short time after being put up. In such cases the bottled beverage may be only slightly opalescent when freshly put up, but after a number of days—sometimes weeks—may develop the dense precipitates. The manufacturer cannot always tell by the appearance of the caramel whether or not it is suitable, and his first knowledge of trouble comes from some complaining customers. Chemical tests of these raw materials would reveal their suitability, thus avoiding these embarrassing and expensive experiences. Caramel being incompatible with some flavoring extracts and entirely satisfactory with others makes it essential to predetermine the characteristics of the caramel bought to ascertain its suitability to the purpose in hand. All carbonated beverages which are sweetened with cane sugar, and not otherwise preserved, require the most careful attention on the part of the manufacturer owing to the readiness with which weak solutions of cane sugar undergo fermentation. A product which is crystal clear when bottled will often in the course of several days, depending upon temperature, develop a cloudiness and deposit a sediment of yeast cells. It is only with scrupulous care and cleanliness in the washing of bottles and in the compounding that difficulties of this nature can be overcome. A syrup which shows but slight evidence of undergoing fermentation will invariably impair the appearance of the finished beverage.

Centrifuge used for whirling out sediment found in bottled goods.



Plating microscopic organisms which cause spoilage in bottled goods.

Even ice manufactured from distilled water frequently contains sediments which appear in discolored patches throughout the cake. When such ice is melted in a clean vessel, a deposit is seen on the bottom. In most cases, sediments of this character are produced by corrosion of the tanks in which the ice is formed.

Many other articles of commerce are subject to changes which result in the formation of sediments. In one instance a mouth wash contained, among other ingredients, boric acid and water extract of a bark rich in lime. After being on the market for some time, a heavy sediment deposited in the bottles, which upon analysis was found to consist of calcium borate. In this case a natural constituent of one of the ingredients was incompatible with one of the other substances contained in the preparation. It was only necessary to eliminate the lime from the bark extract in order to correct the difficulty.

It is therefore apparent that a great many commercial products are seriously affected in appearance by the formation of sediments from varying causes. Sometimes a sufficient quantity of the sediment may be obtained for chemical identification, but in many instances it is necessary to resort to micro-chemical methods. The microscope is a most valuable adjunct to the study of problems of this nature.

While certain rubber manufacturers compound their rubber goods under strict scientific supervision, there are many instances where such goods are still manufactured without regard to sound chemical principles. In the first instance, raw materials are purchased according to the quality desired and at prices commensurate with quality secured, whereas, in the second instance, the purchasing agent takes a haphazard fling at the representations of the salesman and is particularly apt to choose the article which is lowest in price and seems to possess the necessary qualifications; then if a batch of rubber happens to be ruined, the factory foreman is held responsible.

The importance of compounding rubber with a view to securing a satisfactory article for a definite purpose is too rarely considered. Naturally, a composition intended for tires cannot be expected to resist steam, and in the manifold applications of rubber goods it is necessary that the composition should be so controlled as to yield an article of a quality satisfactory for a given purpose.

Many a rubber manufacturer has had goods returned as being worthless because the user found that they did not "stand up" under the conditions to which they were subjected. He naturally assumes that the manufacturer has supplied him with an inferior article, whereas the real reason is that some chemical or physical change has resulted, owing to the manner in which the rubber was used. A concrete example that aptly illustrates this point is that of a rubber manufacturer who employed whiting in some hose that was to be used for conveying a slightly acid liquid. The acid attacked the whiting in a short time and left the hose pitted and unfit for further use.

Compounds containing lead and zinc are frequently used in rubber goods, which, in some stage or other, come in contact with food products, and, in the event of such foods being slightly acid, contamination with lead and zinc would most likely take place. Germany is considerably in advance of our own country in this respect, since a law which went into effect on October 1st, 1888, prohibits the use of rubber containing lead and zinc in nipples for babies' feeding bottles, teething rings and similar articles. Rubber containing lead is prohibited in rubber tubing used for conveying beer, wine and vinegar. Toys, with the exception of large balls, must not contain rubber compounded with lead.

Perplexing problems continually come up for solution in the manufacturing industries. As an example, we might consider the case of hydrogen peroxide. Everyone is familiar with the fact that the solution of hydrogen peroxide deteriorates on standing. In order to enhance the keeping qualities, it is customary for the manufacturer to add a certain proportion of acetanilid. While it is known that hydrogen peroxide solutions containing acetanilid will develop unpleasant

odors on long standing, yet there are certain conditions which, if not properly considered, will result in unusually rapid development of such odors.

One manufacturer had his entire business threatened on account of a peculiar odor resembling iodoform, which developed in his hydrogen peroxide in less than a week after it was made. An investigation disclosed the conditions responsible for this peculiar phenomenon and no further difficulty was encountered, after proper changes in the process were instituted.

Even to-day certain manufacturers fail to realize the economies which result from a proper utilization of their waste materials. In the manufacture of hydrogen peroxide, barium sulphate (technically known as *blanc fixe*) is obtained as a by-product. One manufacturer allowed this product to run down the sewer, whereas he could have obtained over twenty dollars a ton if he had taken the trouble to press out the water and put it in barrels.

The manufacture of hydrogen peroxide is of a type which requires chemical supervision in order to produce a satisfactory product at a reasonable cost. It is necessary to know the strength and the purity of the raw materials used and the yield of hydrogen peroxide obtained, as well as the strength, purity and permanence of the finished product.

Manufacturers of disinfectants, such as coal tar and cresylic acid dips, have gradually been impressed with the need of a scientific supervision of their products. While many of the larger factories engaged in this work are scientifically controlled, there are still many factories where "rule of thumb" methods prevail. The finished product in this instance is expected to be of a certain germicidal strength, and to accomplish this, the composition of the coal tar oils must be ascertained in order to obtain a uniform product. The manufacture itself must be so controlled as to yield a homogeneous mixture, which will give a proper emulsion on dilution with water. Recently many of these manufacturers have been interested in increasing the germicidal power of their products, and this simply emphasizes the effect which bacteriological science has had in establishing the fact that the germicidal power of these products was greatly overestimated in the past. This is true not only of the coal-tar disinfectants, but of many other types as well; for instance, of such products as tooth pastes, mouth washes and similar articles, used in the household.

The object of chemical control is not to conduct chemical analyses simply in order that only the very purest materials may be used in technical manufacture. There is a limit to the purity required of certain materials used in the industries, and it is the chemist's duty to select these materials in accordance with a required standard and to see that these are economically purchased. Take, for instance, the case of abrasives used for polishing glass lenses. A certain abrasive is required which possesses the requisite degree of fineness, so that it will not scratch, and, furthermore, it must have a certain degree of hardness in order to secure the proper cutting qualities. Obviously, the idea is to have an unadulterated material which shows the desired mechanical efficiency. One of the abrasives used for this purpose is rouge or red oxide of iron. This occurs in varying degrees of purity, but the price of rouge depends upon the mechanical treatment to which the producer must subject the material in order to secure the desired qualities. It then becomes the function of the chemist to advise the user in regard to the grade of material which would be satisfactory for his purposes and to further inform him as to whether the price at which it is offered to him is reasonable.

Many instances exist where the manufacturer never consults the chemist until he experiences difficulties. This is by no means unnatural, since the patient seldom consults the physician until illness forces him to seek medical advice. However, we must not lose sight of the fact that human beings are somewhat capable of knowing when their physical condition is such as to require medical attention, while it is impossible for the uninformed manufacturer to foresee his difficulties until perhaps the consumer rejects the goods which have been delivered. The consumer's first impression is that an inferior or adulterated article has been supplied, and it is sometimes exceedingly difficult for the manufacturer to restore the confidence of his customer. The case of a lubricating grease manufacturer who regularly had complaints from his customers owing to the peculiar spots and discolorations which developed in the grease, is an example of how some manufacturers neglect to remedy imperfections in their processes until their business has become seriously affected.

In practically every industry where a chemist's services are vitally necessary, and where there is a failure to employ a chemist, one finds a lack of definite knowledge of the products manufactured, as well as an almost criminal lack of economy. Some enterprising companies, posing as manufacturing chemists, reap a harvest from such firms through the sale of "specialties" claimed to possess certain properties. There are many instances where factory managers purchase products, which, while apparently giving the desired satisfaction, are nothing more than ordinary well known compounds sold under fanciful names. In one instance, a compound was offered to a grease manufacturer which was claimed to purify the tallow. Chemical analysis demonstrated that the action of the chemical was simply that of neutralizing the fatty acids of the tallow.

This same effect was accomplished in the process of the manufacture, so that the new "purifier" was entirely unnecessary. There is absolutely no objection to the company which markets an article having distinct and desirable properties in any given line of manufacture, and secrecy is rarely necessary when the product has real merit. In the purchase of "specialties" the factory manager would do well to seek the services of a chemist in establishing the true value of the product in question.

As in the case of "household" articles such as polishes for metal and furniture, washing powders, cements, etc., there is likewise a tendency to develop "novelties" for the benefit of investors. Many an investor has been ruinously interested in some new and remarkable "development of chemical science." There are many instances where investment in chemical processes is indeed lucrative, provided the particular process is based upon thorough scientific principles and a knowledge of commercial conditions, but the wise investor will rely upon the chemist's help and advice regarding new developments of chemistry, and not plunge into the unknown with his capital.

Maiden Voyage of the "Imperator"

Some Features of the First 900-foot Ship

By J. Bernard Walker

THE "Imperator," the world's first 900-foot ship, was launched by the German Emperor on May 23rd, 1912, from the yard of the Vulcan Works, Hamburg. By the time she floated on an even keel, the great ship displaced some 27,000 tons of water. This was the greatest launching weight on record, and its significance will be realized when it is stated that the mere shell of the ship, as thus launched, weighed more, by 4,000 tons, than did the famous "Deutschland" of the same company, built in 1900, when she was completely equipped, with full coal bunkers and provisions, and carried a full passenger list. When the "Imperator" steamed to the westward on her maiden voyage she weighed, or displaced, much more than double her launching weight, for her displacement at maximum possible draught is not far from 60,000 tons.

The length on deck of the new Hamburg-American liner, from the beak of the huge bronze eagle that projects from the stem, to the stern, is 919 feet, and if we neglect the eagle it is 909 feet. The beam is over 98 feet, and the plated depth is 73 feet.

If we count in the "tank top," or inner bottom of the ship, and the deck that roofs in the topmost tier of rooms, such as the ballroom, winter garden, etc., the "Imperator" has no less than twelve decks—that is to say, she is a 12-story building afloat. Nor is the comparison misleading as a measure of the towering height of the ship, for the first thing that strikes the visitor on going aboard is the unusual height between decks, which in the case of several decks is from 11 to 12 feet. Now 12 to 12½ feet is the average height between centers of floors in a modern New York skyscraper, so that were it not for the great length of these towering ocean liners, which tends to dwarf their height, we should realize that an "Imperator" is a veritable skyscraper of the sea.

If the ship were to be placed in Broadway it would be necessary to cut 18 feet beyond the building line on each side of that thoroughfare for a length of four city blocks, and the roof of the topmost tier of staterooms and assembly halls would extend far above the roof-line of the six and seven-story buildings erected in the pre-skyscraper period.

At the first sight of such a ship as the "Imperator" one fails to grasp its magnitude. This is due to the fact that every dimension of the huge structure is increased in its proper proportion. Thus, the 909 feet of length is offset by the great height of the superimposed decks, overtopped by the huge smokestacks, each 30 feet in its largest diameter. It is only when one of the so-called monster ships of an earlier date is ranged alongside that the overpowering size of the ship of 1913 is realized.

Another scale of measurement that tells the story of size is to consider the dimensions of separate details of the ship. Thus, a single watertight bulkhead, amidships, weighs 60 tons. The shaft jacks or stays weigh 30 tons apiece. Each of the four propeller shafts is 1½ feet in diameter, and each of the four bronze propellers is 16 feet in diameter. Each low-pressure turbine casing is 17 feet in diameter, and 23 feet long, and the rotors within them are fitted with 50,000 blades (the largest 2 feet long), and these weigh 140 tons. The rudder weighs 90 tons, and the sternpost and its jackshafts weigh 110 tons.

The motive power of the "Imperator" consists of four main turbines driving four shafts, steam for the turbines being supplied by water-tube boilers. These water-tube boilers are an innovation in big ocean-going liners. Shipbuilders for the merchant marine have hitherto clung tenaciously to the Scotch boiler—a fine type, it is true, and thoroughly reliable. They have failed, largely through conservatism, to follow the lead of the naval engineers, who many years ago discarded the Scotch for the later type. The Hamburg-American Company are to be commended for breaking away from a too long entrenched practice by adopting the more modern and effective type.

The safety of the "Imperator" is assured by a complete inner skin from the bow to the after end of the engine rooms. Forward of the boiler spaces this skin is worked from 4½ to 5 feet in from the outer shell. Throughout the length of the boiler spaces it consists of the inner wall of the longitudinal bunkers. The bulkheads extend to a height of not less than 20 feet above the waterline, throughout the central two thirds of the ship; toward the ends they are carried higher, the collision bulkhead extending to the upper deck. In their construction close attention was paid to the question of distortion, and all bulkheads are stiffened by heavy I-beams and other shapes to withstand, without distortion or leakage, the pressures which would arise from maximum submersion of the ship due to underwater damage. Furthermore, to insure that the bulkheads were thoroughly watertight, each compartment was filled with water to maximum possible height, and all leaks that developed were closed by calking.

It is of interest to note that when the bunkers of the "Imperator" are filled she will carry some 9,000 tons of coal.

The maximum speed of the ship, on trial, was 23 knots. She carries a reserve of boilers, and it is probable that with all of these going under full pressure the "Imperator" could do 23½ knots.

The Maiden Voyage.

On her maiden voyage the "Imperator" left Cuxhaven drawing thirty-five feet and displacing about 58,000 tons. The test of the seagoing qualities of the ship commenced at once with a head sea and a wind of a strength of eight out of a possible maximum of twelve. The writer, who was on board, was at once impressed with the remarkable steadiness and quietness of the world's latest and largest liner. The wing propellers, which in quadruple-propeller turbine liners have been hitherto a source of troublesome vibration, are in this ship placed well away from the hull, with the result that they rotate in comparatively quiet water, and well away from the belt of water which is drawn along by the skin friction of the hull, and is now known to be a prolific cause of propeller vibration.

No effort was made to push the ship to its full speed. The speed varied from 20¼ to slightly over 22 knots, the lower average speed being due principally to delays due to fog and heavy head seas. Perhaps the most notable feature was the practically complete absence of rolling, or at least of such rolling as was perceptible to the senses. On two days there was a heavy beam sea, the wind on the second day blowing for several hours with about the strength of a whole gale. The ship, under the pressure of the strong wind on her lofty superstructure, assumed a slight angle of heel, moving parallel with the waves with a steadiness that was remarkable, even in so huge a vessel. This absence of rolling is one of the marked advantages of the largest vessels of the "Imperator" type. Rolling can become severe only when the period of roll of the ship coincides with the period of undulation of the waves. In the case of the "Imperator" the period of rolling was about twenty-five seconds, whereas the period of the waves on the days in question was about thirteen to fifteen seconds. It is evident that the larger the ship, the greater will be the difference of periods and the less the tendency to roll. Rolling on a ship of this size is only possible when the wind is in a certain position on the quarter, in which the speed of the ship as it runs with the seas may bring the period of roll and the period of the passage of the waves into coincidence.

The great depth of the ship—her stiffness as a girder—was seen to good effect when she was driving into a heavy head sea. The movement of the expansion joints in the uppermost deck was only between a quarter and three eighths of an inch.

The Articles on Price Maintenance

IT has been found impossible to publish in this week's SCIENTIFIC AMERICAN the article on the relation of the public to price maintenance of retail products, which was promised at the end of Mr. Waldemar Kaempffert's article in last week's issue. In our next issue, however, we hope to give space to this second installment.

Father Knickerbocker's Daily Fare

WHAT does the average New Yorker eat per day? This question is answered graphically in the illustration on our front page, which is based on estimates made by the New York State Food Investigating Commission last year. The annual bill for food is given at $634,683,449. Assuming that this bill is paid by five million inhabitants, the daily cost of living in New York for the average individual is about 35 cents. The annual consumption of beef and other meat food products is 880,000,000 pounds per year, costing about $176,000,000, which amounts to about half a pound of meat per individual per day. If the meat were all beef, it would take about 3,000 beeves to supply the daily demand. It would be impossible for us to show this number in our illustration. Accordingly, we have represented the figure by a single beef three thousand times as heavy as the ordinary beef. More money is spent for meat than for any other item in the food list. In this estimate of meat, poultry and fish are excluded. One hundred million pounds of poultry are consumed per year. Or, if the poultry were all chicken, it would amount to between 54,000 and 55,000 chickens per day, while 150,000,000 pounds of fish are consumed per year, amounting per day to about 82,000 five-pound fish. Next in importance is the canned goods, for which $150,000,000 is paid yearly. The average New Yorker drinks a little less than a pint of milk per day, the total daily consumption being two million quarts and over. It would take a milk bottle nearly one hundred feet high to hold this quantity of milk. New York eats nine hundred million loaves of bread per year, and as it is possible to make three hundred loaves of bread out of a single barrel of flour, the daily consumption of flour used in making the bread is a little over eight thousand barrels.

The following is the table prepared by the New York State Food Investigating Commission. Those who love to juggle with figures will find the table full of interesting possibilities.

Quantity and Value of Food Consumed Annually in New York City.

1.	Beef and other meat food products—880,000,000 pounds at 20 cents	$176,000,000
2.	Milk—800,000,000 quarts at 8 cents	64,000,000
3.	Butter—139,000,000 pounds at 35 cents	48,650,000
4.	Eggs—150,501,630 dozen at 30 cents	45,150,489
5.	Bread—900,000,000 loaves at 5 cents	45,000,000
6.	Sugar—400,000,000 pounds at 7 cents	28,000,000
7.	Poultry	20,000,000
8.	Potatoes—750,000,000 pounds at 2 cents	15,000,000
9.	Fish—150,000,000 pounds at 10 cents	15,000,000
10.	Coffee—45,000,000 pounds at 25 cents	11,250,000
11.	Other vegetables and fruit	5,000,000
12.	Cheese—28,956,000 pounds at 16 cents	4,632,960
13.	Tea—5,000,000 pounds at 40 cents	2,000,000
14.	Cereals	5,000,000
15.	Canned goods	150,000,000
		$634,683,449

The Death of Ernst Ruhmer

ERNST RUHMER, whose name is well known to readers of the SCIENTIFIC AMERICAN as one of the most fertile and ingenious of German inventors, died on April 5th last at the early age of thirty-five. He was a son of an engineer and was educated principally in the technical high school of Charlottenburg, and the universities of Berlin and Giessen. After a brief connection with a prominent firm of instrument makers, he established an electro-physical laboratory. Among his inventions are an apparatus for determining the number of interruptions of fluid interrupters, an instrument for photographically recording and acoustically reproducing sound waves with the aid of a selenium cell, a multiple microphone, a selenium photometer, a device for determining and registering the intensity of daylight, an arc-light interrupter, a television apparatus, and a system of light telephony in which selenium cells and searchlights were experimentally used with great success.

London Chamber of Motor Experts.—To take up work that long has been suggested as worthy of careful consideration, there has been formed in London an organization styled the London Chamber of Motor Experts. The expressed purpose of the Chamber is to take under advisement such patents as inventors deem valuable and to pass on their value to the trade, work which should be easy and which should be productive of authoritative results considering the eminent men who form the association. Carrying the idea still further, the Chamber will undertake to find capital to produce and market devices which in its opinion are meritorious. Weekly meetings will be held when inventors will be permitted to offer their ideas for opinion, a small fee being charged for the service. If, in the opinion of the Chamber the invention gives promise and the inventor is desirous of placing it on the market, the Chamber will undertake the work, after first rendering an estimate of cost to the inventor.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Lighting Buoys with Selenium Cells

To the Editor of the SCIENTIFIC AMERICAN:

It has just come to my notice the letter of Mr. A. K. Sloan in the June 7th issue of the magazine, on automatic lighting of light buoys by means of selenium cells, of which he suggests the use of the selenium cell to control the buoy.

The controlling of buoys by the selenium cell is by no means new, as this has been manufactured by Ernst Ruhmer, and has been in operation on the Baltic Sea for many years. This has been described in Mr. William J. Hammer's book on selenium, etc., and also in a recent article on selenium by Dr. Hausmann in a recent issue of the SCIENTIFIC AMERICAN.

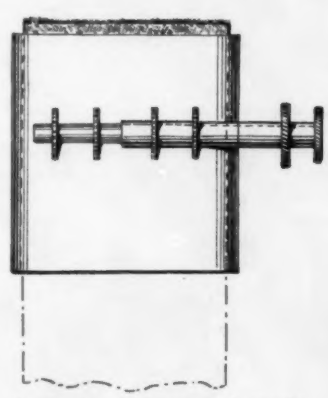
It has been rumored that it might be adopted for use in the Panama Canal. I should think that Mr. Sloan is behind the times. SAMUEL WEIN.

New York city.

Raising a Wick Evenly

To the Editor of the SCIENTIFIC AMERICAN:

I attach hereon the drawing of an arrangement I have devised for raising the wick or wicks of an oil cook-stove straight. In the years during which I have used oil cookers, it has been my experience that after a short period the old-style ratchet spindle refuses to raise the wick evenly. One end is invariably raised higher than the other, and any pan or other kitchen utensil placed over the flame has its bottom covered with an extremely oily soot.



Device for raising a wick evenly.

To obviate this trouble I suggest the ratchet wheels be put on a double spindle; those near the front to be put on an outside or sleeve spindle, and the rear ratchet wheels being placed on a spindle running through the "sleeve" and extending the entire width of the wick tube. With this arrangement it is possible to raise one end of the wick independently of the other, thus adjusting the wick to give an even flame.

REV. ALAN PRESSLEY WILSON.

1535 Edmondson Ave., Baltimore, Md.

Price Maintenance and the Dealer

To the Editor of the SCIENTIFIC AMERICAN

We consider the action of some merchants (jobbers and retailers) in deliberately cutting the standard fixed prices on nationally distributed articles as absolutely unfair and unjust to the producers. It requires a long time and the expenditure of a great deal of money to establish a national demand for any manufactured product. And such demand can never be created or maintained except the product is of the highest merit.

Instead of undermining the progress made by the producer through price cutting, the dealer should welcome an established, fixed selling price, alike to everyone, thereby assuring to himself a living margin of profit in handling such a product.

I trust that through your campaign the public may come to view this proposition in its true and proper light.

JOHN LUCAS & CO., INC.,
ERNEST T. TRIGG,
Vice-President and General Manager.

Philadelphia, Pa.

Our Poor Maps

To the Editor of the SCIENTIFIC AMERICAN:

What you have to say regarding map-making and publishing in this country is wofully true, and I have been swindled out of my money many times before I learned to look abroad for maps that are completely honest.

Because it is not so much the fact that his maps are decades out of date that marks the American map-publisher as lacking in enterprise and self-respect, but it is the unreasonable dishonesty of palming off old maps for new that puts large publishers in a class with fake fire-sale merchants.

I have often paid several dollars for a map bearing a recent date, to find it lacking in ten years old information, to find that the old date had been scratched off the plate and a new date fraudulently inserted. Think of such miserable tricks in the great and noble art of map-making!

As I am on a geographical subject, I wish to point out a hoary, seemingly deathless inaccuracy, which crops out in the article "Salving the 'Lutine.'" The writer mentions "The Barbadoes," whereas the correct name is "Barbados" pure and simple, being a single island of the West Indies, not a group of islands as many people seem to believe. MARION J. FORT.

Los Angeles, Cal.

Controlling the Mississippi With Small Dams

To the Editor of the SCIENTIFIC AMERICAN:

I have followed with great interest the articles which you have published concerning the recent floods in this section of the country. In all of the above I have not read of a single plan that looks practical or feasible. The method suggested to avoid future damage from great floods by building mighty dams and have great reservoirs impound the water does not seem wise or economical. It would require the condemnation of immense tracts of land that are too valuable to be used simply for the storage of waste water. Then, too, there would always be the danger of some of these dams bursting, and with the great amount of water back of them, would at various times do much damage in the valleys farther down. And this is the very danger we want to avoid.

As our civilization progresses, and our farm lands become more and more improved, tiling is done and the water rushed into the streams and rivers, with the resultant flood. The National Government must interest itself in preserving the life and property of all the people, both up stream and down, and just how best to do this is one of the greatest conservation problems before it. As the reservoir plan is unsafe and undesirable, so, too, the suggestion that the country be reforested is untenable; it will never be done, it is too long a process, would require too great an outlay of public funds, and use up lands that cannot be spared. Then, too, the project of widening all the streams will not solve the problem, as that will only aid in carrying off water from one place to make it worse in another.

There is a plan however that will do the business, and at no great expense; that will not cause a lot of the best land to become mere swampy, mosquito-breeding reservoirs. This plan is to have the Federal Government rent or buy the flood lands along all the upper streams, runs, creeks and rivers, and at appropriate places build small dams, with dikes and flood gates to hold back the water to a height of from five to ten feet. These dams can be made at a very small outlay as compared to the large dams for permanent reservoirs.

Then, whenever there is a storm, let the gates be closed and catch the water in the basin thus formed until the dam overflows. After a week or two, one after another of the gates can be opened and allow the water to drain off. The holding back of the water in these small dams will cause a fertile deposit of sediment to be dropped on the flood land that will greatly improve it and not retard the farming interests in the least.

A thousand such dams throughout Ohio during the recent floods would have saved many times their cost in life and treasure.

The flood lands by this plan can be used every summer for raising crops, whether owned by the Government or individuals, and much of the poor, stony gravel patches found in bottom lands to-day, because of the rapid wash of streams, would disappear and become covered with the finest kind of soil.

During the late flood the writer saw the rapid current of a stream—usually nearly a dry bed—wash away forty feet of the bank which had been under cultivation for years. The great damage was done when water backed up by a railway bridge broke loose, and all came down the stream at one time. This stream could easily have been controlled by dams as above described.

By having small and numerous dams this danger of a great rush of water is remedied, for even if one or two should break down, it would have little effect, as there would be other reservoirs to catch and hold the surplus water.

The writer claims for the small dams greater safety, economy in construction and maintenance, increased value in abutting property, and consequent increased production for the State, and less chance for graft in their construction. This last feature might be objectionable to many of the Government experts, but it is worthy of consideration nevertheless.

Fredericktown, Ohio. F. A. DAY, Ph.D.

Melting Metal Under Water

By the Berlin Correspondent of the Scientific American

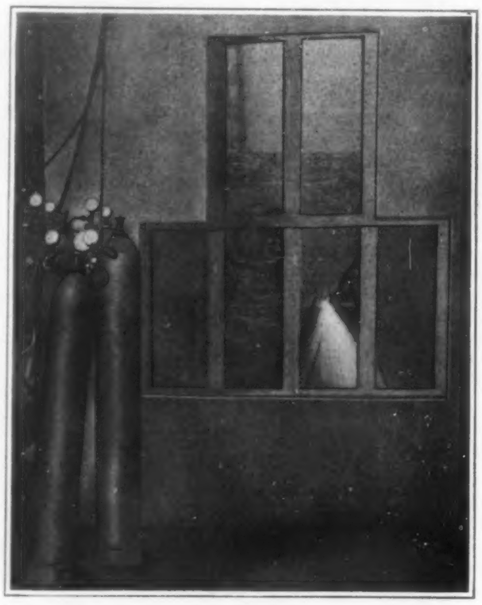
THE cutting of metals under water has entailed great difficulties and enormous cost, the tools and apparatus available for this purpose being utterly inadequate. Apart from the diver's hammer and chisel, compressed air chisels, and, for certain operations, circular saws driven from above, were used in this connection.

While the scope of circular saws is extremely limited, compressed air chisels are quite suitable in most cases, though, of course, the exceedingly high cost and slowness in operation are serious setbacks of this process.

These conditions suggested the use of autogenous metal cutting for submarine work. As the hydrogen-oxygen flame would be immediately extinguished, when immersed in water, the customary process could not be used. A German engineer, Mr. A. Heckt of Kiel, however, designed a bell-shaped burner head which being screwed on an ordinary Griessheim burner, allows the flame to continue burning below water, thanks to a supply of compressed air. This patented process has now been so improved by extensive experiments, that the cutting of metals under water is effected about as quickly as above the surface. In fact, the new tool is said to be ideal in every respect, avoiding as it does the drawbacks of the compressed air chisel, while working extremely rapidly and accordingly most cheaply, and lending itself for use in the most varied applications.

The new process can be used in cutting through iron pile plankings and all sorts of iron structures, cutting up iron or steel wrecks or preparing them for blasting, clipping rivet heads, welding loose rivets, drilling holes, etc. The rate of working is at least twenty times as great as that of compressed air chisels, which accomplishment is bound to prove of immense value in clearing waterways of wrecks and other obstructions interfering with navigation.

At a test recently made of the new apparatus at Kiel harbor, before some prominent engineers and representatives of the Emperor William Canal Department and several berthing companies, an iron plate of 100 by 20 millimeters in an exhibition tank fitted with glass walls, was bored and cut through about 10 centimeters in length by means of the oxygen-hydrogen flame. A diver then went down into the sea, to about 5 meters depth, and after boring a hole into a 60-millimeter square iron, cut through the iron in about 30 seconds. An iron sheet 20 millimeters in thickness was then drilled through and cut in 90 seconds, to above 30 centimeters' length.



Autogenous metal cutting tests in experimental and demonstration tank.

Raising the United States Brig "Niagara"

By W. L. Morrison and A. G. Kessler

THE Perry Centennial to be celebrated from July to September will be as memorable to history as the famous battle in commemoration of which it is to be held. Perhaps the most interesting feature of the Centennial will be the reconstructed brig "Niagara"—Perry's second flagship, which is now almost ready for launching.

Before going into the details of this interesting and historic work, it may be well to acquaint our readers of the important facts relating to the battle of Lake Erie. It is possible, of course, in this article, to give only the briefest outline of this memorable fight, and those who are interested, can secure further details from all of the standard books of American history on the War of 1812.

It was during the early summer of 1813 that Lieut. Oliver Hazard Perry, then a young man of twenty-seven, succeeded against indescribable odds in building and getting together in Presque Isle Bay (Erie, Pa.) some nine ships, which number formed his entire squadron during the famous battle which was to follow. The two largest and most heavily armed vessels were the brigs "Lawrence" and "Niagara;" following these was a smaller ship, the "Caledonia," and six small schooners. The "Lawrence" was chosen by Lieut. Perry as his flagship, and it was she that bore the brunt of what was practically a hand to hand conflict, until so disabled it was necessary to abandon her.

The squadron was hardly completed when it was found that the British fleet was in waiting and ready to strike at any minute. The channel of Presque Isle Bay (leading from the bay into Lake Erie proper) was not very deep, and although the smaller vessels could readily get out of the harbor, it was with considerable difficulty that the "Lawrence" and the "Niagara" were moved over the sand bars in the channel. In fact, it was necessary to take off the armament and raise these vessels by means of pontoons placed on either side so that they would clear the channel.

The British fleet was in sight even during these operations, and consequently when Perry's squadron had hardly cleared port, the preparations for the battle were on in dead earnest—the actual fight occurring about one month later. After some maneuvering, the opposing fleets met on September 10th, 1913, at Put-in-Bay (in the Bass Islands), Lake Erie, where the memorable "Battle of Lake Erie" was fought.

The British fleet consisted of the brigs "Detroit" and "Queen Charlotte," corresponding in size and armament (although somewhat smaller) to the "Lawrence" and "Niagara;" the "Lady Prevost," similar to the American ship "Caledonia," and three small schooners—six in all. It is quite true, therefore, that the American vessels were not only more numerous (nine in all), but they were also more powerfully armed individually.

It would be needless for us to attempt to give the details of the battle, as this is fully and carefully described by many of our able historians. The facts remain, however, that the "Lawrence" was soon in the thick of the fight and borne down upon so heavily by the enemy that she was riddled and almost totally disabled. Perry consequently transferred himself and his few remaining officers and crew in an open boat to the "Niagara," then in command of Lieut. Elliott. The "Niagara" immediately became the flagship, and with her the battle was finished and the British squadron completely defeated.

After the battle, Perry sent his famous message to the Navy Department, which is quoted as often as Caesar's "Veni, Vidi, Vici," and which conveys much the same meaning, "We have met the enemy and they are ours."

There is just one more interesting feature which can hardly be omitted before giving the actual details of the raising of the "Niagara," and that is the controversy which arose between Lieut. Perry and Lieut. Elliott. It was claimed that the "Niagara" did not give the "Lawrence" proper support during the battle, and many assigned this as the cause for the "Lawrence" being literally cut to pieces so early in the fight. Perry himself preferred charges some years after the battle which would have resulted in the court martial of the "Niagara's" first commander, had not Perry died before the trial was to come off. Perry's officers and men stood by him, and Elliott's officers and crew stood by their superior all through the controversy. The result was that many an interesting street fight took place in Erie during the years following the battle, between the crews of the rival ships, and it is said that some of these "scraps" rivaled the famous battle itself.

Two years after the battle of Lake Erie—July, 1815—the "Lawrence" and the two British ships, "Detroit" and "Queen Charlotte," were ordered sunk by the Navy Department in Misery Bay (a small bay and a part of Presque Isle Bay, Erie, Pa.), while the "Niagara" was retained for some years as a receiving ship. The "Lawrence" was again raised in 1876 and sent in sections to Philadelphia for the Centennial there. The building in which she was housed during the exhibition, outside of the exhibition grounds, was destroyed by fire during the Centennial, and all that was left of the old battler was burned.

As the "Niagara" is really the ship on which our article hinges, we will therefore omit further details concerning the other vessels and confine ourselves only to this ship.

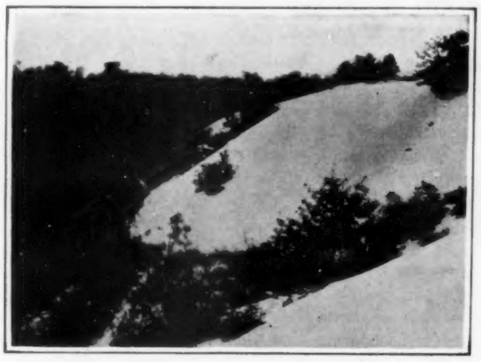
The "Niagara" was also given her final resting place in Misery Bay in the year of 1825 within a short distance from where the "Lawrence" lay. It was at the suggestion of Lieut. W. L. Morrison of the naval force of Pennsylvania that the Perry Centennial Committee first considered the advisability of raising the remains of the famous brig, and this was consequently begun in the fall of 1912. Contract for the raising was let and the work begun at once.

The old ship was covered completely with some six feet of sand and lay in about twenty-five feet of water. During the fall months a sand sucker was used to uncover the buried hull, and when this had been accomplished the actual raising was begun. Four heavy chains were forced under the body of the wreck in the following manner: Two pieces of 2-inch pipe were joined at an angle and attached to a pump giving a hydraulic pressure of approximately 200 pounds per square inch. This pipe then formed a very powerful jet which was

(Concluded on page 585.)

The top picture represents the "Niagara" as she appeared in 1813. Below the picture are views showing how sand and mud were blown away from the sunken hulk, how the wreck was raised, and how the hulk looked after having been lifted out of the water.

Raising Perry's flagship "Niagara."



An active dune covering brush land.

Sand Dunes

How They Are Reclaimed in Europe and in the United States

Reclaiming a sand dune by planting beach grass.

THE best example of the complete reclamation of shifting sand areas is in Gascony on the west coast of France. In the beginning of the nineteenth century this extensive plain was still a sandy desert, but to-day it is, through the work of the French Government, covered with a well-managed pine forest, which supports a large population. Large areas of the Coastal Plain of the United States are covered with enormous dunes, which continually move inland. These gigantic drifts of sand pile up high, covering fences, farm buildings and often vast stretches of valuable timber in their lee. In many places large farms are being buried underneath the sand. Along the Great Lakes entire orchards are smothered, railroads covered up, and extensive areas of arable land made desolate as a desert. Along the eastern coast of the United States from Cape Cod, Massachusetts, to Miami, Florida, hundreds of thousands of acres of barren sand hills greet the eye. Some are perched high on bluffs, others creep down to the water's edge. Years ago most of this stretch of sand land was covered with forests. Man removed the timber, fire after fire followed him, and the sand, which nature had expended centuries in reclaiming, was once more loosed and drifted about by the wind. Thus large areas in the United States are rapidly approaching the former condition of the Landes of Gascony, where 900,000 hectares of sandy moorlands were made productive by properly controlling the shifting sands along the seashore. The success of the work in Gascony has given assurance that similar results may be attained here, provided proper methods of planting are followed.

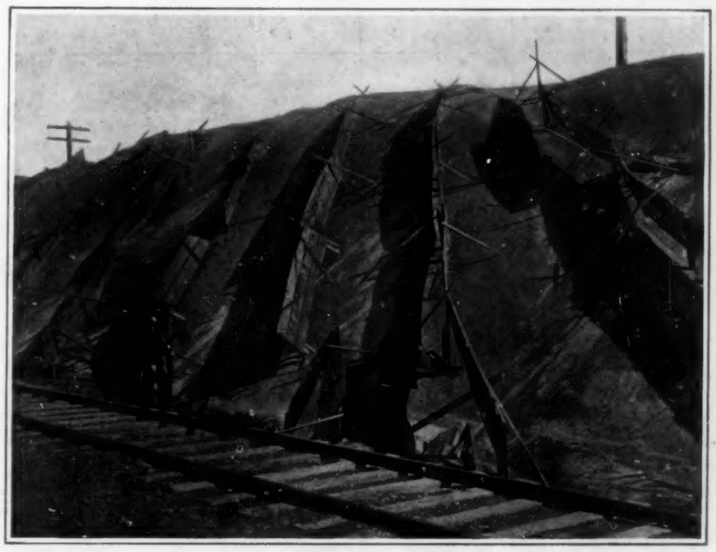
In France the fixation of these sandy barren wastes was started by constructing a littoral dune along the seashore. This dune was the secret of the success in the work. It was simply a bank of sand of certain dimensions, which served as an obstruction to the sand which came from the ocean. On top of this low bank of sand was erected a hurdle to check the sand in its forward movement and in this way the height of the littoral dune was increased. When the first hurdle was covered up another was put in its place, and still another until the dune was about 25 feet in height. This dune, which was about one to two hundred feet from high tide mark, protected the vegetation on the leeward side of the dune from the ocean winds and made conditions favorable for the growth of trees and other vegetation. The surface of the sand was covered with brush arranged like the shingles on the roof of a house. The brush was tied into bundles of about 10 inches in diameter and these were held in place by a few shovelfuls of sand here and there. The seed of beach grass (*Ammophila arenaria*) was then scattered among the brush and it soon sprouted and held the sand in check.

While this system was effective it had to yield to a newer, quicker, and cheaper method. The formation of the littoral dune is a very slow and expensive undertaking, and it has been found that this step can be omitted by planting the windward side of existing dunes with beach grass or any other form of vegetation that can be made to grow in the particular locality It has been conclusively proven after years of effort and almost endless expense that shifting sand cannot be successfully controlled by artificial barriers such as fences of boards (hurdles) or brush.

They serve to check the advance for a time, but later they are covered and rendered useless. Permanency of the sand can only be secured by a forest cover. The building of fences and covering the sand with brush, débris, or manure must be followed by planting or sowing grasses and setting shrubs and trees. Beach grass is able to withstand the action of the sand and wind, especially when it is planted sufficiently close together. If this method is followed the use of brush will be unnecessary. It has rhizomes many feet long by means of which it fixes the sand. The grass continues to grow and to develop new roots and increase in height as the dunes become higher. Wherever a patch of beach grass takes root there the sand blown from the region of greatest supply gathers around it. As the sand spreads, the grass grows through it until the hard, dry blades form the nucleus of thousands of tons of sand. The beach grass is the best among sand-binding plants and is used extensively for this purpose. The chief characteristic of this plant is that when the sand tends to cover it up, its height growth is stimulated in order to keep its tip above the sand. The home of beach grass is along the Atlantic Coast, but its artificial range has been considerably extended. It is now one of the principal sand-binding plants in Europe, and also on the Pacific Coast. Other grasses suitable for planting on the dunes are wild rye (*Elymus arenarius*), bitter grass (*Panicum amarum*), sea oats (*Uniola paniculata*), and blue-joint grass (*Calamagrostis sp.*). All these grasses possess special merit as sand-binding plants, and can be used to advantage within their region of growth.

The reclamation of the sand dunes along the Atlantic Coast has been suggested and advised, but only in a few locations have these plans been put into actual practice. It is possible to control these shifting dunes.

When nature reclaims a sand dune, grasses are the first plants to make a start. These are followed by shrubs and later by trees. For a plant to live and thrive in shifting sand, it must have the power to grow upward as fast as the dune increases in height or to follow the sinking sand, when it decreases in height. It must spread by means of underground stems, and must be a perennial. These conditions are met most successfully along the Atlantic Coast by beach grass. Certain shrubs meet the requirements for binding sand almost as well as some of the grasses. Among these are the native willows, wax myrtles, sand cherry, and holly. Grasses are the first plants on the dunes in the natural process of reclamation and by means of these the movement of the sand can easily be stopped. After this is accomplished shrubs and trees should be planted. While the wax myrtle and sand cherry are good sand binders they do not produce useful wood. The willows and poplars are very valuable in reclaiming dunes and their woods have commercial value. The holly is very easily propagated and grows under adverse conditions. It forms an excellent shelter, and produces a clean white wood, which is used for a good many purposes and can be recommended for planting. The black locust grows in poor soils and is used in Europe for planting reclaimed areas. It also produces a valuable wood and the tree reproduces itself very freely, which is an important consideration in the management of the plantation. The pines indigenous to the region of the dunes are best suited. In New England the white and pitch pines will thrive on sand land after it is fixed. In New Jersey the pitch pine is well adapted and farther south the loblolly pine will make a good growth even on the exposed places.



An ineffective method of controlling shifting sand along the Oregon Short Line (Columbia River), Washington.

Lombardy poplar planted on a shifting dune at Manistee, Mich.

Cuttings of the poplar tree planted in rows of brush.

An effective methcd of controlling a dune threatening railroad property.

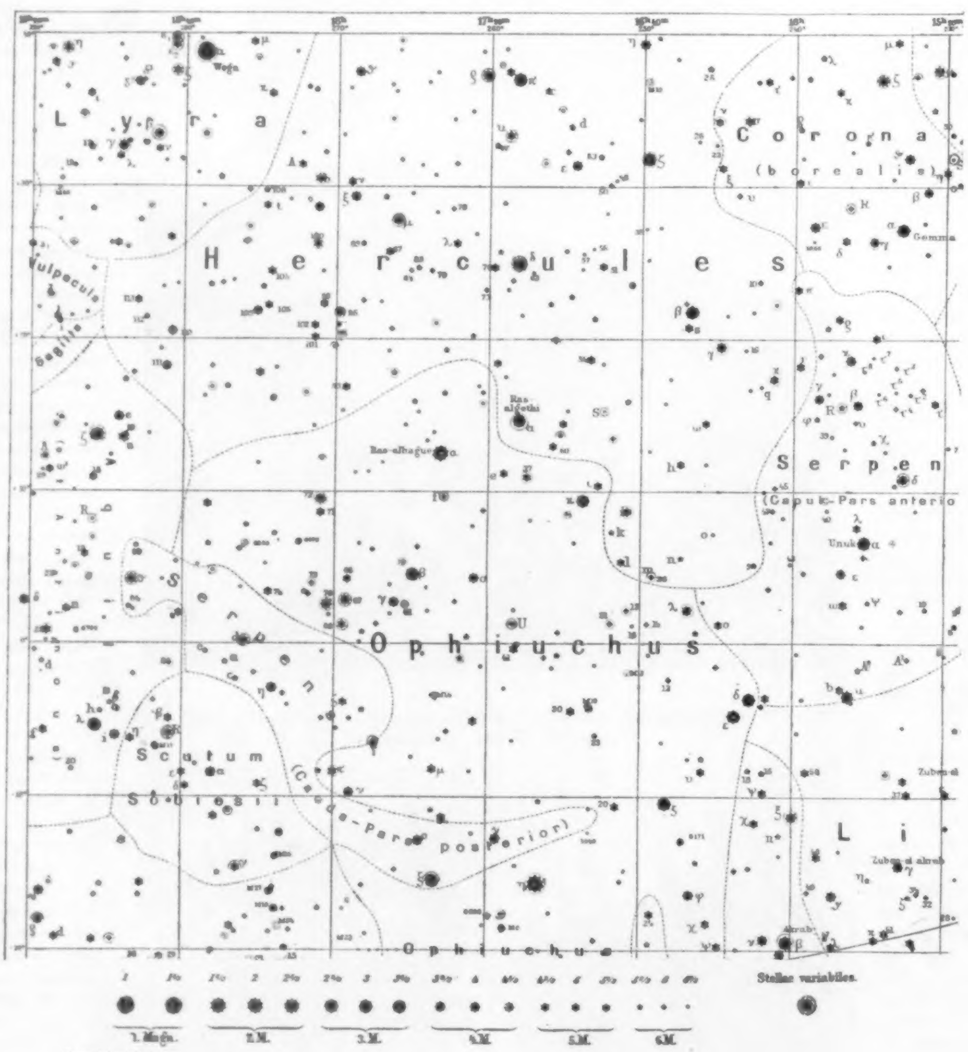
The Heavens in July

How the Navigator Lays Out His Course

By Henry Norris Russell, Ph.D.

THESE words are written in the luxurious library of a modern Atlantic liner. Of the hundreds of passengers on board, one may wonder how many have any realization that the speed and accuracy with which the great ship finds her way across the trackless ocean really depends entirely upon astronomical science.

Navigation—the science and art of determining a ship's position, and laying out her course—in its narrower sense, is but the smaller part of the art of seamanship; but it is an essential part, and, in itself, it is as much a branch of astronomy as of nautical learning. The mariners of early days never willingly ventured out of sight of land. In the days of the Phœnician trade to England for tin their ships doubtless skirted the northern coast of France, far up the Channel, until the chalk cliffs of England actually came in sight to the northward; then only did they dare to cross the narrow seas, and coast slowly along the British shores to their destination.



THE HEAVENS IN THE REGION OF HERCULES

We need not cast any imputations on their courage for this; the lot of a ship blown off to sea, out of sight of any landmark, in those days when there was neither chart nor compass, must have been almost desperate. Their only hope must have been of clear weather, so that they might lay a course, with the aid of the sun or stars, in the general direction of the land, with hopes of finding some haven of refuge before their food and water gave out.

Things are indeed otherwise to-day, but why can the modern mariner sail out confidently into any sea, sure that he can tell where he is, even at the end of a long voyage, within a few miles at most, so long as he can but have a few clear glimpses of the sky? A few simple instruments, whose cost is the merest trifle compared with that of the smallest of seagoing vessels, make the difference. No sane man would put to sea without a compass, a sextant, a chronometer, and the *Nautical Almanac;* and these are all he needs.

At the risk of telling an old story to some readers, let us consider how these instruments are used to find a ship's place. What the captain wants to know are his latitude and longitude. To find the former is a very easy matter, but the determination of longitude at sea has been one of the great historic problems of applied science.

A moment's consideration will show why the second problem is more difficult. Latitude can be determined by observations at a single station, but we can find our longitude only by determining the time of day at our own position (which is easy) and the time at Greenwich at the same instant (which is a far harder thing to do).

The character of the observations which can be made at sea is strictly limited by the peculiar conditions. No fixed instrument can be used on a rolling deck, all measurements must be made with apparatus that can be held in the hand. This practically confines us to the use of the sextant, with which one sights on the sun and the sea-horizon at one and the same time, makes the image of the sun seem to touch the horizon, and then reads off at once the number of degrees (and fractions of a degree) which the sun appears to be from the horizon—technically, its *altitude*. Any intelligent student, on land, or even in perfectly smooth water, can learn in an hour or two to make such observations with an error not exceeding a minute of arc (corresponding to one sea-mile on the earth's surface). To get the same accuracy when the observer's footing can be maintained with difficulty on the deck of a vessel plunging in a high sea demands a degree of skill and dexterity for which those of moderate experience have the most lively respect.

Granted, though, that we have learned how to find the sun's altitude (and, incidentally, to apply several necessary corrections to the crude observed value, and get an accurate result); what good does this do us?

Let us first consider our latitude. If we were on the earth's equator, the equator in the sky would pass right overhead; that is, its highest point would be 90 degrees from the horizon. If we were at the pole, the celestial equator would run all around the horizon—its altitude would everywhere be 0 degree. It is easy to see that in other latitudes—for example, 20 degrees north of the earth's equator—our zenith (the point right overhead) would be 20 degrees north of the equator in the sky, and hence that the highest point of this equator would be 70 degrees from our horizon.

Now we cannot see the equator; but we can observe the sun—and the *Nautical Almanac* tells us just how far the sun is north or south of the equator every day; for example, to-day (June 2nd) it is 20 degrees 9 minutes north of the equator; so when the sun seems highest on the sky, the equator will be at just this distance below it (since our ship is in a northern latitude). If then, for example, the sun at its highest point in the sky, at noon, is found to be 63 degrees 37 minutes above the horizon, the celestial equator must be 41 degrees 28 minutes above the horizon. Subtracting this from 90 degrees, we find that our latitude is 48 degrees 32 minutes.

All this is very simple, and requires nothing but the sextant and the *Nautical Almanac*, for the greatest altitude of the sun can be found simply by making several measurements, beginning a little before noon, and taking the biggest one. To get our longitude we must do two things, find our local time and the Greenwich time at the same moment. The former is a matter of observation. If we know our latitude, it is an easy matter to calculate just at what interval before or after noon the sun will be at any assigned height above the horizon (less than its maximum). We have only to measure the altitude, and may then calculate the time by straightforward trigonometry. This observation should not be made near noon, for even the sun's altitude changes very slowly, and a very small error of observation will lead to a large error in the calculated time. By observing about 9 A. M. or 3 P. M., when the sun is rising or sinking rapidly, much more accurate results can be obtained. There is no great trouble about this, though it appears to the novice a much more difficult problem than the determination of latitude. With the aid of a table of logarithms and the *Nautical Almanac*, a practical worker can solve it in a few minutes. To be sure, he must know his latitude; but the captain always knows this with sufficient accuracy by means of his "dead reckoning" of the distance and direction which the ship has run since the last observation was made.

The real *crux* to the problem is to find what was the Greenwich time at which the observation was made. Nowadays it seems simple enough. Every ship carries at least one good chronometer keeping Greenwich time. The observer needs only to read the time by this chronometer at the moment when he measures the sun's altitude, and then, *if he knows how much his chronometer is fast or slow*, he has the Greenwich time. Then the difference between this and the ship's time gives him his longitude.

But to find the error of the chronometer is the real problem. At the present day a good instrument, carefully handled, is entirely satisfactory for voyages of two weeks' length or thereabout. Every day that the ship is in port, some officer will watch the fall of a time-ball, dropped just at noon by electrical connection with some observatory, and so find out the *error* of his chronometer (how much it is fast or slow) and also its rate (how much it is running fast or slow per day). But the "sea rate" of a chronometer may not be the same as the "shore rate," but a little faster or slower. When a ship has been out a month or more the chronometer may not be running at the same rate that it did in port, and a steadily increasing error will result. On long cruises, therefore, it is necessary to have some way of checking the chronometer. This used to be done by observing the moon—measuring its distance from some bright star. The *Nautical Almanac* gave in advance the calculated distances between the moon and certain selected stars for every three hours of Greenwich time, the change being about $1\frac{1}{2}$ degrees in this interval. By comparing the observed distance with this, the Greenwich time at which the observation was made can be found, and hence the error of the ship's chronometer. But these observations are difficult to make, and very troublesome to reduce, as they involve long and tedious calculations; and they are now so rarely made that the *Nautical Almanacs* no longer publish the old tables of "lunar distances," but leave it to the occasional observer who

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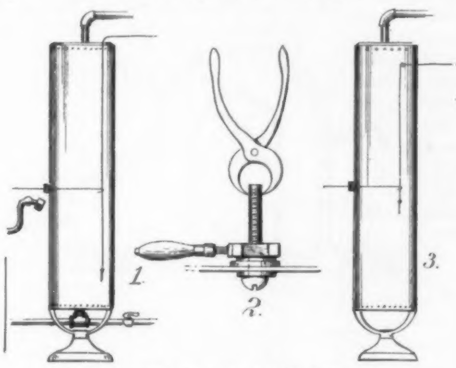
Some Suggestions for the Handy Man

By Henry Klotz

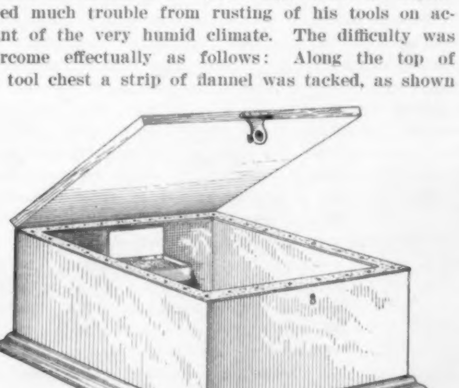
Repairing a Kitchen Boiler.—A leaky kitchen boiler was recently repaired by the writer in the following manner. First the water was drained off and then the holes were carefully enlarged by reaming them with the tang of a file until they were large enough to receive a small stove bolt easily. The hot-water pipe was then disconnected from the boiler and bent slightly to one side, as indicated in Fig. 1 of the accompanying drawing. A stout piece of thread, to the end of



Home repairs of a leaky kitchen boiler.

which a wire nail was secured as a weight, was then lowered through the hole in the top of the boiler. By means of a wire hook the thread was caught and pulled through the pipe opening in the side of the boiler. The wire nail was then disconnected and, instead, a stove-bolt with a washer on it was tied to the thread and pulled carefully through the hole in the top of the boiler. In this position it was held with a knife blade pressed against it until the thread was disconnected and a leather washer, metal washer and nut could be screwed down on the projecting end. The bolt was long enough to permit of its being grasped with a pair of pliers and held firmly while it was being turned up with a wrench (as indicated in Fig. 2). The other hole in the boiler was in the side, near the top. Here the same method was pursued, except that a piece of wire with an eyelet at the end of it was used. Through this eyelet the thread was passed. The wire kept the thread away from the side of the boiler, so it could readily be hooked and brought through the opening for the hot-water pipe. After several days of use it was found that the water was leaking again, because the leather was rendered brittle by the heat. The work had to be done over again, but in place of leather, washers were made out of electric splicing tape or tire tape, bending a piece back and forth on itself six times and making a hole in the middle with two cross-cuts. In a similar way a long leak in the top of the boiler was mended by using a piece of brass with a washer of tire tape and fastening it in place with two bolts.

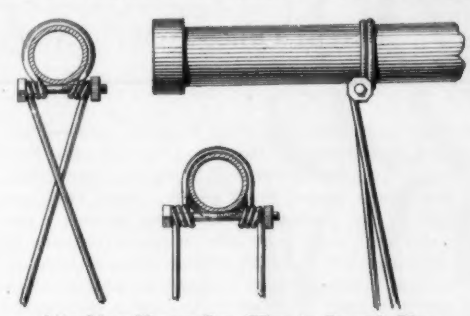
To Prevent Rusting of Tools.—The writer found himself in Florida a few years ago, where he experienced much trouble from rusting of his tools on account of the very humid climate. The difficulty was overcome effectually as follows: Along the top of the tool chest a strip of flannel was tacked, as shown



Rust-proof tool chest.

in the sketch, so that when the cover was fastened down it made the chest practically airtight. Then a large cigar box was procured and fastened inside the tool chest. The box was filled with unslaked lime. The cover was left on the cigar box, and always kept open except when the tool chest was moved about when, of course, it was closed to prevent spilling the lime.

Attaching Guy Wire to Smooth Pipe.—Many wireless telegraph amateurs have experienced great difficulty in trying to attach the heavy guy wires firmly to the smooth galvanized iron pipe mast which is frequently employed as a support for the aerial wires. In order to preserve the full strength of the mast it is, of course, essential not to drill any holes or cut any nicks in the pipe for the wires to fit into. The writer recently found himself up against the same problem, and solved it in the following manner: The guy wire was first wound three times around the end of an iron bolt near the head, then twice around the pipe, and then three



Attaching Heavy Guy Wire to Smooth Pipe.

times around the bolt again at the other end. The nut was then tightened up slightly so as to hold the wire in position while the other ends were anchored, and when this had been done it was screwed up tightly, and the projecting end of the bolt cut off.

Removing a Revolver Barrel Without a Wrench.—Recently the writer went on a hunting expedition to the Far West, in the heart of the Rockies, to a place over a hundred miles from the nearest railroad station. Our guide had a revolver in which the barrel was worn out from much shooting, and as there were no gunsmiths handy, we sent to the factory for a new barrel, and then without tools we proceeded to remove the old one and substitute the new one in the following simple and satisfactory manner. A stout piece of rope was first procured, and one end of it securely tied with thread to the muzzle of the barrel. The rope was next wound tightly around the barrel to its full length and then around a steel bar, as shown in the sketch. A piece of square oak about 1½ feet long was next introduced into the frame, from which the cylinder had

An improvised pipe wrench.

been removed, and then pressure was exerted on the steel bar and the oak stick in opposite directions, but without results, as the barrel was seemingly rusted in tightly. The rope was then removed, the barrel heated and plenty of oil run around the thread where it screwed into the frame. After this had been done and the barrel cooled down it was tried again, and this time it was unscrewed quite easily.

The new barrel was then screwed into place as far as it would go by hand, and then wound with tape to protect the highly polished blued surface from being scratched. The rope was then fastened and wound around as previously described, and then turned up tight into the frame. The revolver has had hundreds of shots fired from it since then, and found to be as satisfactory as though fixed up by an expert gunsmith.

Some Automobile Repairs

By F. C. I.

THE following are a few repairs made by the writer which may be found useful to the owner of an automobile. If he does not wish to do the work himself he may hand the suggestion on to his repair man.

Tightening a Loose Automobile Wheel.—In the older models of automobiles, many of which are still in use, the rear wheels are keyed to a straight axle. This gives rise to much trouble, for if the wheel once becomes loose, it soon works the key back and forth, wearing the key seat and shaft to such an extent, that it is almost impossible to tighten the wheels securely. The best way of overcoming the difficulty is as follows: The two halves of the axle are removed and the spindles (*A*, Fig. 1) are tapered in the lathe for the full length of the wheel hub, making them a quarter of an inch smaller in diameter at the outer end. A bushing *B* is made to fit the wheel and is bored out to the same taper as the spindle, but is made about an eighth of an inch longer than the spindle. The old keyway in the spindle is then trued up and made deeper and a new key is fitted into it. A slot is cut in the bushing on a shaper or with a hacksaw, which allows the bushing to be slipped upon the spindle with the key in place. The ends of the spindle are bored out and tapped to receive cap-screws *G*. A washer *F* is made of the size of the hub tip, and with a hole for the screw *G*. The bushing and wheel are slipped in place and the key is driven home. The slit bushing is forced in and held in place securely by the washer *F* and screw *G*, while its tapered surface wedges the wheel securely to the spindle and keeps the wheel perfectly true. The hub cap covers all. If the bushing *B* is too short a split washer *C* may be added.

Lengthening a Valve Stem in a Motor.—Valve clearance knocks are caused by too much space between the valve stem and its lifter; a sharp metallic knocking results as the lifter hits the stem, and also as the valve

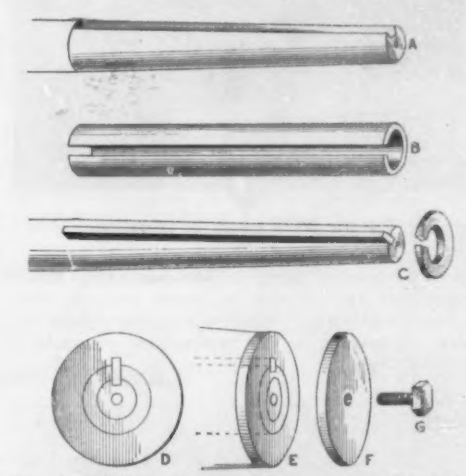


Fig. 1.—Method of tightening a loose automobile wheel.

head hammers the valve seat on its return. The valve lifter rises more slowly at first than later, hence the advantage of as little clearance as possible, for besides allowing the lifter to come more gently in contact with the stem, the valve head is forced to move more slowly as it approaches its seat, hence it seats gently. It will readily be seen that for quiet running, assuming the cams not to be worn and of the proper contour, this space should be reduced to the minimum. Too much space results often in loss of power. The thickness of a visiting card is about right for some, even a little less for others, depending on the expansion of the stem from the heat of the engine. Some engines are not provided with means for adjusting this clearance. An easy and entirely satisfactory method of reducing this space in such a case is as follows:

An empty brass cartridge of almost if not quite the proper size to fit the valve stem is easily secured. A punch is driven into the cartridge to flatten the closed end. If the cartridge is a little too large and fits loosely, place it upon a hardwood peg and crimp it in three or four places with a chisel, as shown in Fig. 2, or reduce it to proper size with a tap wrench.

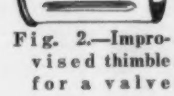


Fig. 2.—Improvised thimble for a valve stem.

It can now be forced on the stem and will stay in place. File off the end of the cartridge until there is sufficient space. If this space closes when the cylinder gets hot, file off just a little more. The engine will tell you by refusing to go, or stopping when the cylinder heats, that more clearance is required. The comparatively soft metal of the cartridge has a cushioning effect, which also does much toward eliminating this unpleasant knocking.

Emergency Repair for a Roller Bearing.—Recently one of the spiral rollers in a Hyatt bushing in an automobile bearing was broken near one end and the piece caused trouble by becoming crossed, with the obvious danger of grinding and damaging the bearing. No new bushing of proper size was at hand and the repair was made by inserting a small rod through the roller and riveting each end. This temporary repair seems likely to prove permanent, as the owner of the car has never called for the new part which was ordered.

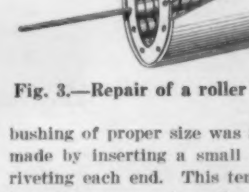


Fig. 3.—Repair of a roller bearing.

Inventions New and Interesting

Simple Patent Law ; Patent Office News ; Notes on Trademarks

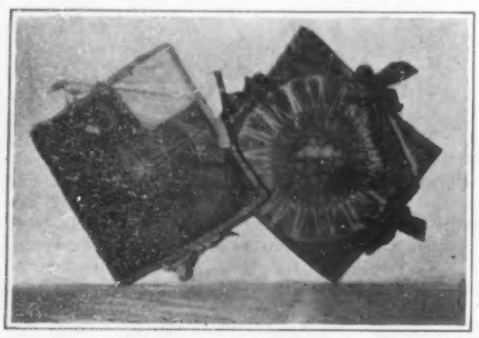
Electric Batik Work

By Dr. Alfred Gradenwitz

BATIK work has been practised since time immemorial by the natives of Java, and consists of producing patterns by means of liquid wax on a bright fabric, paper or the like, which is eventually dyed.

Electric Batik pencil in operation.

Such parts of the fabric as correspond to the pattern having been covered with hot liquid wax, the whole is dipped into a dye-stuff liquid, when the covered portions will take on no dye, whereas the remainder is dyed uniformly.



Specimens of Batik work.

After drying, the same fabric (which is now multi-colored) can again be covered with a pattern which, by the Batik process, is preserved in the former color, while the background takes a darker hue, and the same operation can be repeated several times until the background has become very dark.

After removing the wax by washing the whole piece of fabric with gasoline, the various colors are brought out most effectively on the dark background. Wonderful color effects are thus obtained, such as can be insured by no printing process, the fabric being permeated entirely with color, which is best appreciated on holding the fabric against the light.

The possibilities of Batik work are by no means so limited as would appear at first sight. The same process can, in fact, be applied to wood stained in several hues (or engraved), as well as to metal dyed or etched by chemicals. Especially beautiful etchings can thus be produced on copper, brass, etc.

The instrument used by the Japanese in applying the wax is some sort of small funnel fixed to a handle with a fine opening in which the wax is heated over a coal fire. Similar attachments, or else closed reservoirs terminating underneath in a point and a small opening are used in Europe where Batik work has been introduced. In connection with all these devices the wax must however be reheated from time to time (over an alcohol, gas or gasoline flame), and it cools rapidly during use. This lack of uniformity in the temperature of the wax, of course, entails a number of drawbacks, while the liquid wax immediately after heating flows out in a very energetic jet liable to produce too thick lines or even blots, the outflow soon becoming very sparing, as the wax cools down. In order to insure an absolutely uniform temperature of the wax, a German lady, Frau Gertrud Lamprecht-Gewecke of Nuremberg, has devised an electrically heated Batik pencil. Apart from uniformity in the thickness of lines, this insures a considerably more rapid work (the continual reheating being dispensed with) and far greater ease and accuracy.

The electric Batik pencil is a cylindrical wax holder to the lower part of which is screwed a mouth-piece with a fine bore. A fine sieve placed in the wax holder above the mouth-piece will retain any impurities of the liquid wax.

The wax is heated by the heating coil the lead of which passes through the handle, being connected in its interior with a flexible cord by means of which the Batik pencil can be joined up directly to a contact box for 110 or 120 volts (or through a series resistance to higher tensions). The Batik pencil can be used with continuous as well as alternate currents, its consumption being about the same as that of a small or medium-sized incandescent lamp.

An Iceberg Indicator

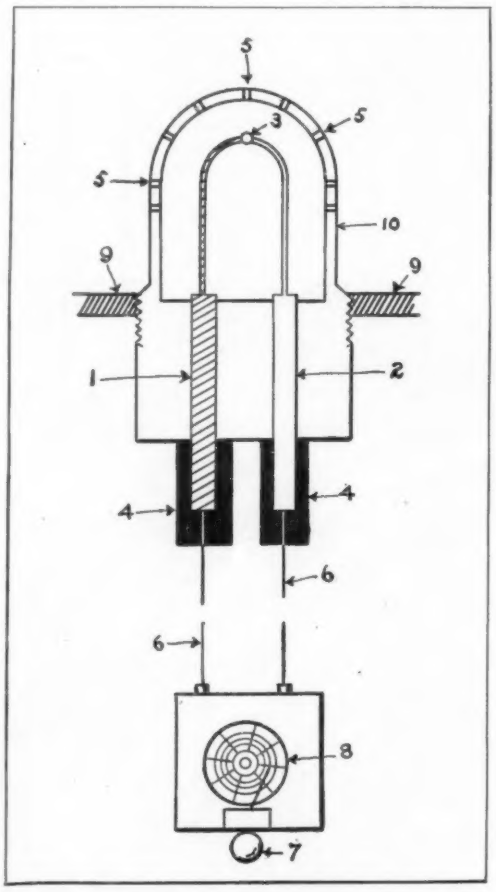
PROF. HOWARD T. BARNES of McGill University, Montreal, Canada, has blazed the way in the study of the detection of large bodies of ice through the reading of the temperatures of the sea water at a distance from the source of chill. For this work Prof. Barnes has employed a microthermometer capable of registering variations of a thousandth of a degree Fahrenheit, and his researches have given to the subject a new significance.

Following the loss of the "Titanic," the United States Naval Authorities maintained for some time an ice patrol service in the mid-Atlantic, two of our scout cruisers having been detailed to alternate on that duty. Interest is now revived because of the Government's intention to renew this ice patrol in the coming season of greatest danger. These vessels can only maintain surveillance over a limited area, and there is every reason why each sea-going steamer traversing the North Atlantic should have its own means for certainly detecting the proximity of ice.

Many clever minds have given a good deal of study in the past months to the devising of instruments for this service, and certainly there is a need for some apparatus which can be relied upon, especially when approaching and passing through the waters south of Newfoundland, where confusion is engendered by the continual conflict between the Labrador current and the Gulf stream.

The prime desideratum is an instrument that will work at all times, one upon which the navigator can confidently depend.

With this latter and essentially practical aim in mind, Mr. William H. Bristol has worked out his detector, and the ingenious instrument promises to fill a want of long standing. The apparatus is fundamentally very simple, and its arrangement is such that its fitness for duty or its working order can be quickly determined at any time. The navigator cannot afford to trust to facilities which are uncertain in their functioning, and this has been the ruin of more than one cleverly-designed mechanism. The Bristol detector is based upon the well-known phenomena of the thermo-electric couple. For the sake of those that may have forgotten their school-day physics, let us explain briefly.



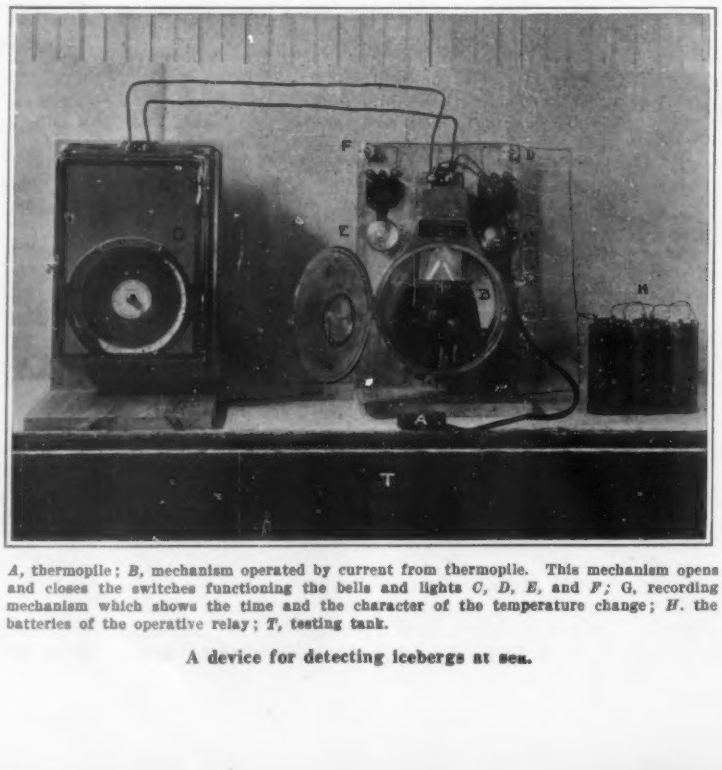
1 and 2 are dissimilar metals forming the elements of a couple; 3, the point where the elements join. This is the active end of the couple; 4, 4, the insulated ends of the couple; 5, 5, openings to the sea, which may be closed if the couple be in touch with the metal envelope 10; 6, 6, the circuit connecting with the alarm system 7 and the recording mechanism 8; 9, the outside or bottom plating of a ship.

The thermopile, placed below water in contact with the sea, records changes of temperature.

Two half rings of dissimilar metals when joined together and either suddenly heated or chilled at one of these connecting points, give birth to a feeble current which will flow until the opposite juncture has acquired the same temperature. The sensitiveness and the potential of a thermo-electric couple depend upon the character of the two associated metals. The strength of this current can be increased by employing a number of couples, and a group of these bound for a single service is what is termed a thermopile. In order to get a sufficient electric impulse, Mr. Bristol uses a thermopile which is suitably placed below the waterline of a vessel and installed where it can feel quickly delicate differences of temperature in the outlying water. It is not necessary to expose the thermopile directly to the water: the desired effect may be obtained by having the exciting end of the thermopile in contact with the outside plating of the ship or with the thinner skin of a protecting envelope which is in touch with the sea.

Simple as this sounds, the proper elements of the electric couples were found only after a great deal of experimenting upon Mr. Bristol's part. The text-books

(Continued on page 588.)



A, thermopile; *B*, mechanism operated by current from thermopile. This mechanism opens and closes the switches functioning the bells and lights *C*, *D*, *E*, and *F*; G, recording mechanism which shows the time and the character of the temperature change; *H*. the batteries of the operative relay; *T*, testing tank.

A device for detecting icebergs at sea.

Lightning Prints

(Concluded from page 576.)

British Meteorological Society by James B. Shaw in 1857: Six sheep were killed by lightning near the city of Bath in the year 1812. When the skins were taken from the animals, a facsimile of a portion of the surrounding scenery was visible on the inner surface of each skin. The pictures caused a great sensation when exhibited at Bath; and Mr. Shaw, who was a school-boy at the time of this occurrence, states that he and his schoolfellows were so familiar with the place where the accident occurred, that when the skins were shown to them they "at once identified the local scenery so wonderfully represented." This story would be more impressive if the narrator had not been looking back through a vista of forty-three years, and to his boyhood days, when he presented the facts to the world.

Another case, which possibly admits of a different explanation, is recorded in Casaubon's "Adversaria," published in 1610, and has often been quoted. The following version of the story is given by Flammarion:

"On a summer's day, about 1595, while divine service was in progress in the Cathedral at Wells, two or three thunder-claps were heard of so terrible a nature that the whole congregation threw themselves down on the ground. Lightning occurred at the same instant, but no one was hurt. The astonishing thing about the affair lies in the fact that crosses were afterward found to have been imprinted upon the bodies of some of those present at the service. The Bishop of Wells assured the Bishop of Ely that his wife told him she had a cross thus imprinted upon her; and that on his being incredulous she had shown it to him, and that he himself found afterward that he, too, was thus adorned—on his arm, if I remember right. Some had it on their breast, some on their shoulders. It is from the Bishop of Ely that I have these facts, which he tells me are well authenticated."

We have quoted this case because it appears to have led Dr. Carl du Prel[5] to suggest a totally different explanation of lightning-prints from that proposed by Rindfleisch, and one which, though certainly not needed to account for the ordinary forms of the phenomenon, might perhaps be invoked in the case just cited and a few others. According to Dr. du Prel, the worshipers in Wells Cathedral were marked with crosses by a process analogous to "stigmatization." He assumes that lightning struck a metal cross over the altar, toward which the congregation was facing. This object, brilliantly illuminated by the electric discharge, would, in his opinion, have furnished the dominant suggestion needed to accomplish the impression of a cruciform image upon the bodies of suitable subjects; i. e., persons susceptible to the ideoplastic process. We give this suggestion for what it is worth. It is certainly simpler to assume, in the case in question, that branches of the electrical spark actually struck some of the congregation, even though they were not conscious of any shock, and that the so-called crosses were merely intersecting marks produced by the discharge in the ordinary manner.

Raising of the U. S. Brig "Niagara"

(Concluded from page 580.)

placed in position at one side of the wreck and gradually forced under the old hull by means of the hydraulic pressure behind it. The sand and mud was blown away inch by inch and the pipe jet forced farther and farther under the wreck until ropes attached to the ends of this pipe jet could be fished up on the opposite side of the wreck and a heavy chain attached to these ropes, drawn underneath the vessel. The difficulties encountered during these operations may be left to the imagination when it is stated that most of this work preparatory to raising was done through holes cut in the ice covering Misery Bay and during extreme weather conditions.

After the four chains—one forward, one aft and two amidships—had been placed around the sunken hull, they were made fast to strong beams, the beams being supported on pontoons on either side of the wreck. Strong levers some twenty to twenty-five feet in length, were then used in drawing up the chains link by link until the old "Niagara" was brought to the surface. This was accomplished without any damage or breakage of the hull, and the wreck was then gradually shifted toward the shore. One of our illustrations shows a small part of the old battler as she appeared during the operation of moving her shoreward. She was finally beached, and prepared as will be described later for rebuilding. What was left of the old ship may best be seen from the accompanying photograph, taken shortly after beaching.

The hull was then set squarely into position, and a proper bed and ways constructed. The lines of the vessel, all of her principal dimensions, etc., were then taken and transferred to a temporary mold loft. These lines and other data were transferred by the writers. They are wonderfully "fair and sweet" and show how advanced was the art of ship building a century ago.

The spar plan as nearly as could be obtained from all possible sources, reveals many of the old forms of rigging used one hundred years ago.

The hull was found to have been constructed of various woods, frames of white oak, planking of 3-inch oak, bulwarks of pine, stanchions of red cedar and black walnut. The keel of 14-inch by 18-inch oak, is wonderfully well preserved and will be used in its entirety in rebuilding. The keelson is 10-inch by 12-inch, while the frames are 12 inches wide at the keel and have a center distance of 21½ inches. The "Niagara" is 118 feet from stem to stern post, has a beam of 30 feet and a draft of approximately 8½ feet.

A very interesting feature is that every other frame is a "natural knee," giving the vessel wonderful strength and the ability to bear severe shocks and strains. Wooden pins (called "tree-nails") and hand hammered wrought iron spikes were used in the original construction. Our illustration shows the skeleton ready for rebuilding, most of the old planking having by necessity been removed. The bow of the vessel is on the right hand of the photograph. The "natural knees" previously mentioned are also shown, and the general construction of ribs, frames, etc. The seams were found to have been calked with oakum and filled with tea lead, which is in itself a very interesting and unusual feature.

Another odd feature in construction shows that the steeler in the dead wood aft had been carved out of a single piece of wood instead of being made of separate planks.

The armament of the vessel consisted of eighteen 32-pound carronades and two long 12-pound guns, the latter being used forward as "bow chasers."

The total firing weight of the "Niagara" for her twenty guns was 600 pounds of shot and shell. How insignificant this seems when we realize that *one* of our modern 12-inch guns hurls no less than 850 pounds a distance of ten miles with deadly acuracy!

The rebuilding of the "Niagara," true in every detail to the original ship, is progressing rapidly.

A fact of historic value is that the "Niagara" will probably be the last large wooden sailing vessel which will ever be built on the Great Lakes. She will be towed from port to port during the celebration, by the historic U. S. S. "Wolverine" (formerly the "Michigan"), which ship herself is over seventy years old, and which has the distinction of being the oldest iron ship in the United States Navy. The "Wolverine" is now held in reserve and is used as the training ship for the Naval Force of Pennsylvania stationed at Erie, Pa.

[5] Quoted in *Annales des sciences psychiques*, v. 7, 1897, p. 214.

The Motor-driven Commercial Vehicle

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The Editor will endeavor to answer any questions relating to mechanical features, operation and management of commercial motor vehicles.

Logging With a Motor Truck

MOTOR trucks occasionally invade the forests and bring out loads of timber, but rough logging is a branch of the lumber industry in which little is heard of the motor truck. While the logging locomotive is probably immune from any inroads upon its usefulness by gasoline trucks, enough progress has been made in gasoline logging to promise a wide field of activity and warrant serious consideration of the power truck from the standpoint of what it has actually accomplished. A five-ton motor logging truck was recently built for a man in Cleveland, who has had it in service for nearly a year in the woods near Brecksville, in the southern part of Cuyahoga County, Ohio.

On a small scale, this truck has done the work of the logging locomotive, the skidder and the donkey engine. In addition, it automatically loads the truck by its own power and then transfers its load from truck to flat car by that same power.

While there can be no direct comparison between the work of this single truck and the enormous tonnage capacity of log trains, a careful analysis of the work of this truck, bearing in mind that it is merely a single unit, reveals interesting possibilities. It is built with a six-cylinder motor and in all other respects, except the wheels, it is of standard design. The driving wheels are built of steel, with a twenty-two-inch tread having the usual corrugated surface of tractor wheels, and enabling the truck to run over rough surfaces and soft ground such as will be encountered on any timber tract.

A power winch, driven off the transmission of the truck, is built amidships and controlled by a lever similar to the brake and gear shifter. Loads as high as six tons have been carried without difficulty, although the rated capacity of the truck is five tons. By proper use of the power winch and a simple scheme of rope and chain tackle, the crews have loaded 1,000 feet of lumber on the truck in twenty minutes. Furthermore, its remarkable capacity for loading is availed of in many ways, notably in the salvage of fine specimens of hardwood, which frequently fall into ravines and cannot ordinarily be recovered except at prohibitive cost.

The customary haul of the truck is approximately five tons for an average distance of about six miles. On arrival at the railroad siding the rapidity with which the truck drops its load and pulls the logs upon freight cars by the use of its power drum and cable, produces a great saving of time and labor.

The logs ordinarily are dropped on the ground and then rolled up on the cars. If no cars are available, the crew simply drops the load and returns to the woods, knowing that the loading operation can be done quickly by the truck when the cars are ready. The truck therefore has no idle minutes.

The Log of a Horse Drawn Truck

THE Electrical Engineering Department of the Massachusetts Institute of Technology has published a leaflet known as "Research Bulletin No. 3," which contains some interesting observations on the daily work of the horse, showing how much of the time the truck must stand idle while it is being loaded and unloaded.

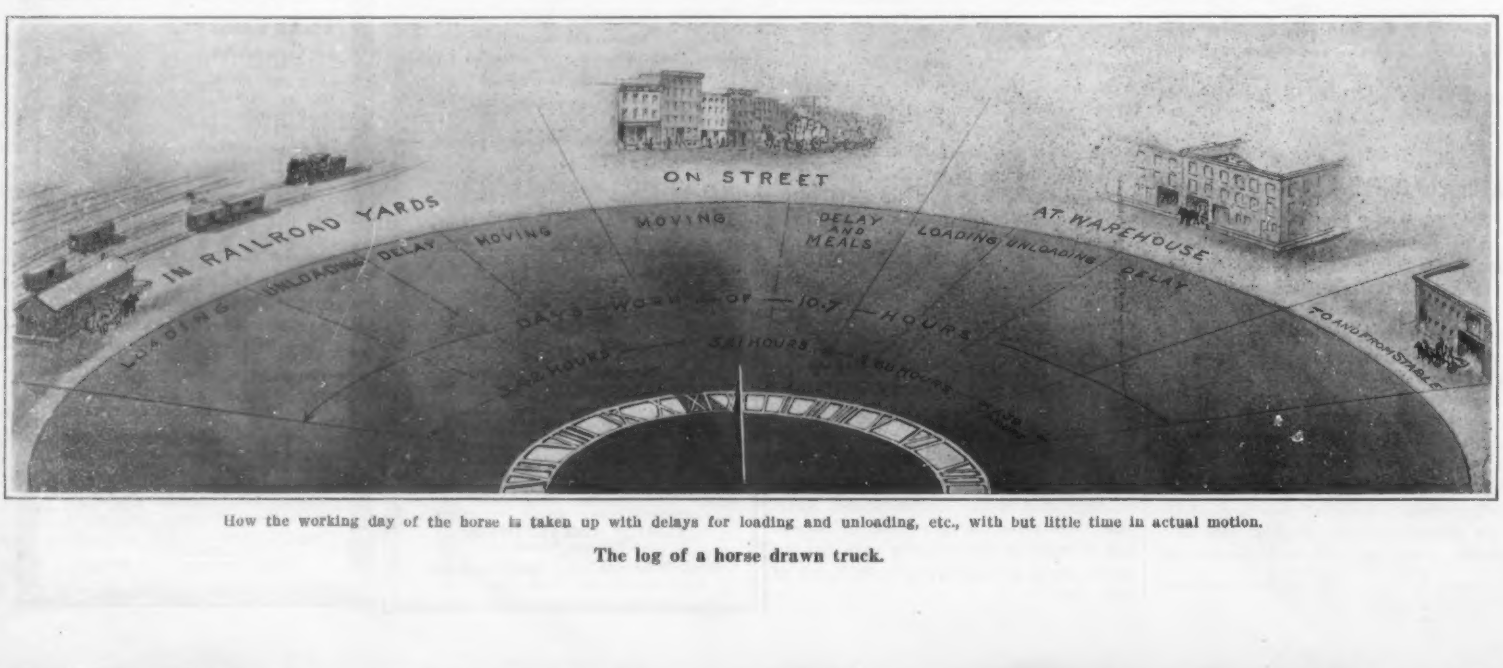
A six-ton motor logging truck taking on a load of lumber.

A study has been made of freight delivery in Boston. Careful records were made of every movement of the vehicles from the time they left the stable in the morning until they returned at night. An analysis is published of the daily wagon performance based on eighteen days' observation of four different wagons handling miscellaneous freight. The average working day, or the time out of the stable, was 10.7 hours. It was found that 32 per cent of the day was spent at the railroad yards, 25 per cent of the day at warehouses, and the remainder of the day, or 43 per cent, on the street. Of this latter time, 13 per cent of the day was spent in traveling from and to the stable in the morning and the evening. The time spent in travel between warehouse and freight yards was 19 per cent of the day, during 15 per cent of which there was at least a partial load on the wagon. To illustrate these figures clearly and show how much of the time the horse stands idle, we have prepared the accompanying drawing with the truck schedule laid out on a sun dial. Thirty-two per cent of 10.7 hours is 3.42 hours, or three hours and twenty-five minutes. This was the time spent at the railroad station, and it was made up of nearly 12 per cent for loading, about 7 per cent for unloading, and about 5 per cent for delays of different kinds. The actual time moving at the railroad station was but 11 per cent of the day. Not counting the time of travel to and from the stable, which as our dial shows amounted to 1.39 hours, or one hour and twenty-three minutes, only 3.21 working hours, or three hours and twelve minutes, were spent on the street, during two hours and two minutes of which the truck was in motion. One per cent of the day, or six minutes, the truck was delayed by congestion on the street. The remainder of the time, or one hour and four minutes, was taken up with meals and miscellaneous delays. At the warehouses we have the same delays. The time consumed in loading, 6 per cent, was thirty-nine minutes, unloading, 8 per cent, fifty-one minutes, while miscellaneous delays amount to 11 per cent, or one hour and ten minutes. Out of the whole day the motor truck was moving only four hours and sixteen minutes, leaving over six hours and a half in which the horse was doing no pulling, and only one hour and thirty-six minutes was spent in traveling between warehouse and freight yards with at least a partial load on the wagon.

To compete with the horse the motor truck can demonstrate its superior mobility not during the ten hours of the day, but only during four and a quarter hours of moving. It can get to work and return to its garage in quicker time; it can move about in the railroad yards and maneuver into position for loading and unloading in less time than is taken by the horse drawn truck; and it can move from the railroad yards to the warehouse in less time, provided there is not too much congestion on the street. But the time of loading and unloading at the railroad yards and at the warehouse and the time taken out for meals would be the same if the driver is to have his noon hour. And so, although the motor truck may be much faster than the horse drawn vehicle, it can demonstrate its superiority only during a very small per cent of the day. It is for this reason that so much attention is being paid to the loading and unloading of motor trucks at the present time, for the longer the hours of moving the greater will be the superiority of the motor truck. Dumping bodies are used for unloading the trucks, and special loaders, also separate bodies which may be removed for loading and unloading. Everything, in fact, is being done to avoid delays of all kinds, so that the motor truck can be on the street as much as possible, and spend most of its time in active competition with the horse.

Motor Trucks in Porto Rico

THAT Porto Rico presents an excellent opportunity for an extensive use of motor trucks is the assertion of Mortimer Remington, commercial agent of the United States for Porto Rico. The little island, with its population of more than a million, now stands eleventh in importance of the export markets of the United States. Its own export business has increased from a yearly total of $17,000,000 in 1901 to $92,000,000 for the fiscal year ending June 30th last, which speaks well for American occupancy. The only railroad on the island skirts the shore, and as most of the products and produce come from the interior, an extensive system of highway transportation is essential. In the present system the ox cart is the principal transportation vehicle used. Motor trucks, however, have received a foothold. There are now sixty-six on the island and their number is sure to increase rapidly. Road conditions in Porto Rico favor the use of motor trucks. There are over 900 miles of stone roads, and the main highways are unsurpassed anywhere in the world. This accounts for the fact that there are now over 1,000 motor vehicles of all types there, and at the present rate of increase this number will be doubled in the next eighteen months.



How the working day of the horse is taken up with delays for loading and unloading, etc., with but little time in actual motion.

The log of a horse drawn truck.

An Iceberg Indicator

(*Concluded from page 584.*)

are a safe guide only up to a point, and it was beyond this point that the inventor had to go in order to get a working unit which would meet responsively the temperature ranges to which it might be subjected in every-day service the year round and the world over.

During his laboratory trials, Mr. Bristol's model apparatus gave a noticeable record of changes in heat of a fifth of one deg. Fahr., and this is practically about as refined a sensitiveness as would ordinarily be required. By insulating the non-contact end of the thermopile it is possible to increase the working period. By adjusting the measure of this insulation a time "lag" can be fixed to suit the different speeds of the vessel, so that a record will be made and an alarm given at definite intervals. This apparatus is not a temperature-recording mechanism, *per se;* its prime purpose is to give warning of *sudden* variations involving the warmth of the sea water. If the change is a temperature drop, the current flows in one direction, and if a rise, it circulates contrariwise. The thermopile is wired to signaling and recording apparatus in the chart house. One carries a smoked dial upon which a pointer traces a line: that line marking the time and the sharpness of the temperature change. The other apparatus is a combined visual and audible alarm. The thermopile current is just strong enough to operate the recording point of one mechanism and the electric contacts of the other, by which a relay of sufficient strength is called into service.

If the impulse current is caused by chill, a red light is illumined and a shrill bell sounded. A green light glows and a low-toned bell rings when the temperature rises. The significance of these signals must be weighed agreeably to meteorological conditions, the locality, and the season.

How does Mr. Bristol make sure that the man on the bridge can know that the detector is on duty? A separate circuit leads down to the thermopile from the navigational station, and near the active end of the couples a little resistance is placed in this circuit which heats quickly when the current flows. This heating is sufficient to affect the thermopile, and in doing this to give answering signals on deck. When these signals fail then the detector is out of order. This test can be made at any time, and response is virtually instantaneous when all is right. The value of this will be readily appreciated by any practical seaman.

The Heavens in July

(*Concluded from page 582.*)

may have need of them to compute them himself from other data which are still given.

The method of the future, for correcting chronometers at sea, will undoubtedly be by means of wireless telegraphy. Signals are sent out at a specified time every day from the powerful station at the Eiffel Tower, from the great German station at Norddeich, the American station at Arlington, near Washington, D. C. In a few years it is hoped that, by international arrangement, a network of signal stations may be established so that any ship on the seas may receive a daily time signal. The problem of finding the longitude will then at last be solved for good.

A century ago, when the art of watchmaking had by no means reached its present perfection, the best available chronometers could be trusted for only a few days, and lunar observations were necessary on voyages of any length. A little earlier, even these were of little use, for the theory of the moon's motion had not been developed with sufficient accuracy to allow of good predictions of its position.

The Heavens.

We give again this month a detailed map of a portion of the northern skies, which is now well observable, high in the south, in the early evening. The semi-

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INQUIRY COLUMN

READ THIS COLUMN CAREFULLY. You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. There is no charge for this service. *In every case it is necessary to give the number of the inquiry.* Where manufacturers do not respond promptly the inquiry *may* be repeated.
MUNN & CO., INC.

Inquiry No. 9302. Wanted the address of the manufacturer of the Greenfield flexible armored conductors or cables. This is a double galvanized, spiral conductor or cable.

Inquiry No. 9303. Wanted the name of manufacturer who could make newly patented articles made from 13 to 22 gage sheet aluminum.

Inquiry No. 9304. Wanted the names and addresses of manufacturers of a second hand bag cleaning machine on the order of a carpet cleaning machine.

Inquiry No. 9305. Wanted the name and address of concerns making paper letters and figures.

Inquiry No. 9306. Wanted small hardware and other specialties to be sold in notion and grocery stores. Wanted to buy wholesale.

Inquiry No. 9307. Wanted to buy a machine for honing and stropping safety razor blades on a commercial scale.

Inquiry No. 9308. Wanted woven glass fabric for manufacturing purposes in large quantities. The glass is spun.

Inquiry No. 9309. Wanted to buy small woven tubing of small diameter for use over the temples of spectacles where they go around the ears.

Inquiry No. 9310. Wanted addresses of manufacturers of good selling articles for mail order business catering to the trade of agents.

Inquiry No. 9311. Wanted names and addresses of manufacturers of hatpin heads made of colored glass; also medals of all shapes.

Inquiry No. 9312. Wanted to buy a machine which will pick up a weight the size of a lima bean by vacuum process. Must be able to pick up dust, gravel, etc. Must be operated by electricity and be easily portable.

Inquiry No. 9313. Wanted to buy Leather Held Horse Shoes used temporarily when shoe cannot be nailed on. In other words a Leather Boot with iron shoe at bottom—strapped over horse's foot.

Inquiry No. 9314. This enquirer is in the market for some patented articles which he could purchase and manufacture with an investment of from $5,000 to $10,000. The name of the party will be supplied to any of our readers on application.

Inquiry No. 9315. Wanted the name and address of a concern manufacturing novelty ink wells.

Inquiry No. 9316. Wanted the names of manufacturers and manufacturers' agents who make patented articles and other useful devices which appeal to the public and which can be used in a mail order business and by canvassers.

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The * Indicates that the Article is Illustrated with Engravings.

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circle of Corona Borealis is near the northwest corner of our map, and the bright star Vega near the northeast corner. With these as guides the other stars may easily be found.

The telescopic observer will find much of interest in this region. In Corona Borealis ζ is a nearly equal pair, separable in a small telescope. β and δ Serpentes are also separable with moderate power.

In Hercules we may note the bright double stars δ (whose components are moving in different directions in the sky, and have no real connection) α (a very fine pair, of strongly contrasted colors, the principal star being brilliantly red), and the fainter but easy doubles ρ Herculis, 95 Herculis (with contrasted colors) and μ Herculis, whose 9th magnitude companion, 30 seconds away, is itself double, but separable only with a powerful instrument.

The bright star ζ Herculis is an interesting binary with a period of 35 years; but the components are unequal, and little more than 1 second apart, so that a telescope of at least six inches aperture will be required to show them well.

About 5 degrees north of this—two thirds of the way to η Herculis—the map shows a faint object, which is visible even to the naked eye, and appears in a field-glass as a hazy round object. This is a great globular star-cluster, the finest in the northern sky, containing many thousands of stars. The view of this object which can be obtained with a small telescope falls far short of the magnificence of the photographs secured with large instruments; but it is nevertheless well worth looking at.

Farther south and east θ Serpentes is a fine wide double, within the reach of a strong field-glass, and 70 Ophiuchus (almost exactly in 18 h. R. A.) is a remarkable binary, now resolvable with three-inch aperture or less. Lyra, in the northwestern corner of the map, is full of interesting things. Vega, one of the whitest stars in the northern sky, has a faint companion of the tenth magnitude, which does not share in its proper motion, and is probably immeasurably more remote.

β Lyrae is a very remarkable variable, composed of two very large stars of small density, which revolve about one another almost in contact in a period of about 13 days and materially eclipse one another. The neighboring star γ Lyrae affords an excellent standard of comparison, since the variable is almost equal to it at maximum, and less than half as bright at minimum.

ζ and δ Lyrae are wide pairs, resolvable by a field-glass. Still more interesting is the famous "double-double" star Epsilon (ϵ) Lyrae, just northeast of Vega. The smallest optical power will split this into two, in fact, the two stars, which are 207 seconds apart, can be seen separated by keen eyes without instrumental aid. With a three-inch telescope, each component is found to be double.

The Planets.

Mercury is evening star throughout July, and is best visible in the early part of the month, setting about 8:50 P. M.

Venus is morning star in Taurus, rising about 2 A. M. She is at her greatest western elongation on the 3rd, and appears in the telescope as a half-moon.

Mars is a morning star, too, about 20 degrees west of Venus, but is far less conspicuous. Jupiter is in opposition on the 5th, and is in sight all night, though very far south for observation in our latitude.

Saturn is morning star in Taurus, and is in conjunction with Venus on the 21st, being 1 degree 18 minutes north of her.

Uranus is in opposition on the 29th. He is then in Capricornus.

Neptune is in conjunction with the sun on the 18th, and is quite invisible.

The moon is new at midnight on the 3rd, in her first quarter at 5 P. M. on the 10th, full at 1 A. M. on the 18th, and in her last quarter at 5 A. M. on the 26th. She is nearest the earth on the 6th, and farthest off on the 22nd.